MEMORANDUM

AND

ARTICLES OF ASSOCIATION

AND

BY-LAWS

OF THE

BRITISH MEDICAL ASSOCIATION

INCORPORATED UNDER THE COMPANIES ACTS OF 1862 AND 1867,
OCTOBER 21ST, 1874.

WITH ALTERATION OF ARTICLES BY SPECIAL RESOLUTION, AT THE ANNUAL MEETING HELD AT BATH, AUGUST 8TH, 1878, CONFIRMED AT BIRMINGHAM, AUGUST 27TH, 1878, AND ALTERATIONS BY SPECIAL RESOLUTIONS OF THE ANNUAL MEETING HELD AT LIVERPOOL, AUGUST 3RD, CONFIRMED IN LONDON, AUGUST 17TH, 1883, AND ALTERATION BY SPECIAL RESOLUTION OF THE ANNUAL MEETING HELD AT CARDIFF, JULY, 1885, CONFIRMED IN LONDON, AUGUST 17TH, 1885, TOGETHER WITH THE BY-LAWS ADOPTED AT THE ANNUAL MEETING HELD AT EDINBURGH, AUGUST 3RD, 1875, WITH ALTERATIONS AT THE ANNUAL MEETING HELD AT BATH, AUGUST 8TH, 1878, AND OF ADJOURNED ANNUAL MEETING, HELD IN LONDON, AUGUST 17TH, 1885: AND AT THE ANNUAL MEETING AT BRIGHTON, AUGUST, 1886.

LONDON:
OFFICE OF THE BRITISH MEDICAL ASSOCIATION,
429, STRAND, W.C.
1887.

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OFFICE OF THE BRITISH MEDICAL ASSOCIATION,
429, STRAND, W.C.
1887.

MEMORANDUM OF ASSOCIATION

OF THE

BRITISH MEDICAL ASSOCIATION.

1. The name of the Association is the "British Medical Association."

2. The registered office of the Association is to be in England.

3. The objects for which the Association is established are the promotion of medical and the allied sciences, and the maintenance of the honour and the interests of the medical profession by the aid of all or any of the following :—

(*a*) Periodical meetings of the members of the Association, and of the medical profession generally, in different parts of the country.

(*b*) By the publication of such information as may be thought desirable in the form of a periodical journal, which shall be the journal of the Association.

(*c*) By the occasional publication of transactions or other papers.

(*d*) By the grant of sums of money out of the funds of the Association for the promotion of the medical and the allied sciences in such manner as may from time to time be determined on.

(*e*) And such other lawful things as are incidental or conducive to the attainment of the above objects.

4. The income and property of the Association,

from whatever source derived, shall be applied solely towards the promotion of the objects of the Association as set forth in this Memorandum of Association, and no portion thereof shall be paid or transferred directly or indirectly by way of dividend or bonus or otherwise by way of profit to the persons who at any time are or have been members of the Association, or to any person claiming through any of them, provided that nothing herein shall prevent the payment in good faith of remuneration to any officers or servants of the Association, or to any member of the Association or other person in return for any services actually rendered to the Association.

5. The 4th paragraph of this Memorandum is a condition on which the licence is granted by the Board of Trade to the Association in pursuance of Section 23 of the Companies Act, 1867. For the purpose of preventing any evasion of the terms of the said 4th paragraph, the Board of Trade may from time to time, on the application of any member of the Association, impose further conditions, which shall be duly observed by the Association.

6. If the Association act in contravention of the 4th paragraph of this Memorandum, or of any such further conditions, the liability of every Director hereinafter called member of Committee of Council shall be unlimited, and the liability of every member who has received any such dividend, bonus, or other profit aforesaid, shall likewise be unlimited.

7. Every member of the Association undertakes to contribute to the assets of the Association in the event of the same being wound up, during the time that he is a member, or within one year afterwards, for payment of the debts and liabilities of the Association contracted before the time at which he ceases to be a member, and the costs, charges, and expenses of winding up the same, and for the adjustment of the rights of the contributories amongst themselves such amount as may be required, not exceeding the

sum of one guinea, or in case of his liability becoming unlimited, such other amount as may be required in pursuance of the last preceding paragraph of this Memorandum.

We, the several persons whose names and addresses are subscribed to this Memorandum, are desirous of being formed into an Association in pursuance of this Memorandum of the Association.

Dated this 17th day of August, 1874.

NAMES, ADDRESSES, AND DESCRIPTIONS OF SUBSCRIBERS.

ARTICLES OF ASSOCIATION

OF THE

BRITISH MEDICAL ASSOCIATION.

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1. For the purpose of registration, the number of the members of the Association is declared not to exceed 100.

Altered by Special Resolution, passed Aug. 2nd, confirmed Aug. 17th, and registered Aug. 31st, 1883.

2. The ~~Committee of~~ Council of the Association hereinafter mentioned may, whenever the objects of the Association require it, register an increase of members.

3. The Association is established for the purposes expressed in the Memorandum of Association.

QUALIFICATION, ETC., OF MEMBERS.

4. Every person who at the date of the registration of the Association is an ordinary member of the unincorporated body called by the same name within the meaning of their laws, dated August 1873, and has paid all subscriptions due from him in accordance with such laws, shall be entitled to become a member of the Association (hereinafter called a member) upon signing an agreement in that behalf.

New Article added by Special Resolution; passed August 8th, confirmed August 27th, and registered Sept. 2nd, 1873.

No female shall be eligible for election as a member of the Association.

5. The terms and conditions upon which every person not entitled to become a member under Article

4 is to become a member, and also under what circumstances any member may be expelled from the Association, so as to cease to be a member thereof, shall be prescribed from time to time by the Association in general meeting.

6. Every member shall pay a subscription to the Association of one guinea per annum, which shall entitle him to receive the ~~Publications~~ of the Association for the current year; the subscription shall date and be considered due in advance on the 1st of January in each year commencing on the 1st of January, 1875, except in the case of a member admited on or after the 1st of July in any year, when the subscription for such part of the year shall be half a guinea in advance.

Altered by Special Resolution, passed August 8th, confirmed August 27th, registered September 2nd, 1878:—"JOURNAL" substituted for "Publications."

~~7. Any member whose subscriptions shall not have been paid on or before the 31st of December of the current year, shall, without prejudice to his liability to the Association, be suspended from all privileges of membership until he shall have paid the same and all subsequent subscriptions (if any) up to the time of payment. No member shall (except in case of his death or expulsion) cease to be a member without having given previous notice in writing of his intention in that behalf, on or before the 30th day of November in the current year, to the Secretary hereinafter mentioned, and paid all arrears of subscriptions (if any) due from him.~~

Struck out in pursuance of Special Resolution, passed Aug. 2nd, confirmed Aug. 17th, registered Aug. 31st, 1882, and the following Article substituted therefor.

7. Any member whose subscription shall not have been paid on or before the 31st of December of the current year, shall, without prejudice to his liability to the Association, be suspended from all privileges of membership, and at the end of the succeeding year, if the arrears be still unpaid, he shall cease to be a member, and shall be ineligible for readmission until he shall have paid all arrears due at the period of his suspension. No member shall (except in case of his death or expulsion, or his ceasing to be a member under the previous provisions of this article) cease

to be a member without having given previous notice in writing of his intention in that behalf, on or before the 1st day of December in the current year, to the Secretary, hereinafter mentioned, and paid all arrears of subscriptions (if any) due from him.

8. Honorary members, without any of the liabilities of members, may be elected from time to time, by the Association, in general meeting, on the recommendation of the Council hereinafter mentioned. The following classes of persons shall be eligible as honorary members :

(*a*) Members of the medical profession of scientific eminence residing in the United Kingdom, in the colonies, or in foreign countries.

(*b*) Gentlemen residing in the United Kingdom, in the colonies, or in foreign countries, not belonging to the medical profession, but distinguished in sanitary or physical science.

(*c*) Gentlemen who may have rendered distinguished service to the Association. No honorary member shall be entitled to any vote, or any further privilege than that of attending the annual general meetings, and of receiving copies (not exceeding twenty-five in number) of any memoir or communication of his own printed by the Association. Every honorary member shall cease to be such member upon a resolution to that effect passed in general meeting.

Publications.

9. A journal under the title of the British Medical Journal, shall be published weekly in London by the Association, and shall be conducted by a paid editor, who shall be responsible for all that appears in its pages, except such matters as may be printed by direction of the ~~Committee of~~ Council. The Journal shall contain papers on medical science, and shall be considered the medium of communication between

Altered by Special Resolution, passed Aug. 2nd, confirmed Aug. 17th, and registered Aug. 31st, 1883.

articles of association

9

9 Paid Editor who shall be responsible for all that appears in the papers of the Journal

Journal shall contain papers on medical science and shall be the medium of communication between the members of the association.

28 Editor hold office as shall be determined from time to time by the Council

cf Officers Pap 16 - Parag 12

29 Journal & Finance C. composed of 15 members with officers of As.

Three members a quorum.

30 Committee meet not less than 4 times a year

18 General Meeting on requisition of 100 members to meet within 26 days.

members of the Association. In it shall be inserted all notices of places and times of meetings of the Association, and any other Association business which the ~~Committee of~~ Council require to be inserted therein. Transactions shall be published occasionally if the funds of the Association permit. Once in every year, a list of the members and honorary members, and their addresses, shall be published in the JOURNAL.

GENERAL MEETINGS.

10. The first general meeting shall be held at Birmingham on or before the 20th day of December, 1874.

11. ~~Subsequent general meetings shall be held once in every year, commencing with the year 1875, at such time and place as may be prescribed by the Association in general meeting; and if no time or place is so prescribed, a general meeting shall be held on the 20th day of August in every year, commencing as aforesaid at such place as may be determined by the Committee of Council.~~

Struck out in pursuance of Special Resolution, passed Aug. 2nd, confirmed Aug. 17th, and registered Aug. 31st, 1883, and the following Article substituted therefor.

11. Subsequent general meetings shall be held once in every year, commencing with the year 1875, at such time as shall be fixed by the Council, and at such places as may be prescribed by the Association in general meeting; and if no time is so fixed, a general meeting shall be held on the 20th day of August in every year, commencing as aforesaid, and shall, if no place is so prescribed, be held at such place as may be determined by the Council.

12. The above-mentioned first general meeting and subsequent annual general meetings shall be called ordinary meetings, and all other general meetings shall be called extraordinary.

~~13. The Committee of Council may, whenever they think fit, and they shall upon a requisition made in writing by any fifty or more members, convene an extraordinary general meeting.~~

Altered by Special Resolution, passed Aug. 2nd, confirmed Aug. 17th, and registered Aug. 31st, 1883. The words "*Committee of*" erased.

Altered by Special Resolution, passed July 30th, confirmed Aug. 14th, and registered Aug. 25th, 1885.

13. The Council may, whenever they think fit, and they shall upon a requisition made in writing by any ~~fifty~~ *one hundred* or more members, convene an extraordinary general meeting.

14. Any requisition made by the members, shall express the object of the meeting proposed to be called, and shall be left at the registered office of the Association.

Altered by Special Resolution, passed Aug. 2nd, confirmed Aug. 17th, and registered Aug. 31st, 1883. The words "*Committee of*" erased.

~~15. Upon the receipt of such requisition, the Committee of Council shall forthwith proceed to convene a general meeting, and if they do not so within twenty-one days from the date of the requisition, any fifty members may themselves convene a meeting.~~

Altered by Special Resolution, passed July 30th, confirmed Aug. 14th, and registered Aug. 25th, 1885.

15. Upon the receipt of such requisition, the Council shall forthwith proceed to convene a general meeting, and if they do not so within twenty-one days from the date of the requisition, any ~~fifty~~ *one hundred* members may themselves convene a meeting.

Proceedings at General Meetings.

16. Seven days' notice at the least, specifying the place, the day, and the hour of meeting, and, in case of special business, the general nature of such business, shall be given to the members in manner hereinafter mentioned, or in such other manner (if any) as may be prescribed by the ~~Committee of~~ Council, but the non-receipt of such notice by any member shall not invalidate the proceedings at any general meeting.

Altered by Special Resolution, passed Aug. 2nd, confirmed Aug. 17th, and registered Aug. 31st, 1883.

17. All business that is transacted at an extraordinary meeting, and also all business that is transacted at an ordinary meeting, with the exception of scientific and professional discussions and addresses and the consideration of the accounts, balance sheets, and the ordinary reports of the Council ~~and the Committee of Council~~ and the other routine business of the Association, shall be deemed special.

Altered by Special Resolution, passed Aug. 2nd, confirmed Aug. 17th, and registered Aug. 31st, 1883.

18. No business shall be transacted at any meeting unless a quorum of members is present at the com-

mencement of such business, and such quorum shall not be less than twenty-five.

19. If within one hour from the time appointed for the meeting a quorum of members is not present, the meeting, if convened upon the requisition of members, shall be dissolved. In any other case it shall stand adjourned to the same day in the following month, at the same time and place; and if at such adjourned meeting a quorum of members is not present, it shall be adjourned *sine die*.

20. The President of the Association (to be appointed as hereinafter mentioned), or, in his absence, the President of the Council (to be appointed as hereinafter mentioned), shall preside as Chairman at every general meeting of the Association.

21. If at any meeting, the President, or President of the Council, is not present within fifteen minutes after the time appointed for holding the same, the members present shall choose some one of their number to preside as chairman.

22. The Chairman may, with the consent of the meeting, adjourn any business from time to time, and from place to place, but no business shall be transacted at any adjourned meeting other than the business left unfinished at the meeting from which the adjournment took place.

23. At a general meeting, unless a poll is demanded by at least twelve members, a declaration by the Chairman that a resolution has been carried, and an entry to that effect in the book of proceedings of the Association shall be sufficient evidence of the fact, without proof of the number or proportion of the votes recorded in favour of or against any such resolution.

24. If a poll be demanded in manner aforesaid, the same shall be taken in such manner as the Chairman directs, and the result of such poll shall be deemed to be the resolution of the Association in general

meeting. In case of an equality of votes at any general meeting, the Chairman shall be entitled to a second or casting vote.

Council and Committee of Council.

Struck out in pursuance of Special Resolution, passed Aug. 2nd, and confirmed Aug. 17th, registered Aug. 31st, 1883, and the following Article substituted therefor.

25. The business of the Association shall be managed by the Committee of Council, and the respective constitutions, duties, powers, and modes of procedure of the Council and Committee of Council, shall be determined on from time to time by the Association in general meeting.

25. The business of the Association shall be managed by the Council, and the constitution, duties, powers, and mode of procedure of the Council, shall be determined on from time to time by the Association in general meeting.

Altered by Special Resolution, passed Aug. 2nd, confirmed Aug. 17th, and registered Aug. 31st, 1883.

26. The ~~Committee of~~ Council may take such steps as they think proper for having transferred to the Association, or to trustees for it, the complete ownership of and control over, for the purposes and benefit of the Association, all the property and choses in action belonging to the unincorporated body hereinbefore referred to, and may get in and receive payment, and give good discharges for, and otherwise deal with such property and choses in action in like manner in all respects as if the same had originally belonged to the Association.

Branches.

27. For the wider diffusion of the benefits of the Association, members may form themselves into separate bodies to be styled Branches. Branches shall be so constituted, and shall have such powers and privileges, and be subject to such obligations, as shall be determined on from time to time by the Association in general meeting.

Officers.

28. ~~There shall be the following officers of the Association, viz.: a President of the Association, a President Elect, Vice-Presidents, a President of the Council, a Treasurer, an Editor of the JOURNAL, and a Secretary, who respectively shall be designated or elected, and hold office for such period, and have and enjoy such duties, powers, and privileges, and, as to the Editor of the JOURNAL and Secretary, receive such emoluments, as shall be determined from time to time by the Association in general meeting.~~

Struck out in pursuance of Special Resolution, passed Aug. 2nd confirmed Aug. 17th, registered Aug. 31st, 1883, and the following Article substituted therefor.

28. There shall be the following officers of the Association, viz.: a President of the Association, a President-Elect, Vice-Presidents, a President of the Council, a Treasurer, an Editor of the JOURNAL, and a Secretary. The officers (other than the Editor of the JOURNAL and the Secretary) shall respectively be designated or elected, and hold office for such period, and have and enjoy such duties, powers, and privileges, as shall be determined from time to time by the Association in general meeting. The Editor of the JOURNAL, and Secretary, shall respectively be designated, or elected, and hold office for such period, and have and enjoy such duties, powers, and privileges, and receive such emoluments, as shall be determined from time to time by the Council

Votes of Members.

29. Every member shall have one vote and no more. No member shall be entitled to vote at any meeting unless all moneys which, at the time of such meeting, shall have been due from him to the Association for more than one year, shall have been paid.

NOTICES.

Amended by Special Resolution, passed Aug. 2nd, confirmed Aug. 17th, and registered Aug. 31st, 1883, by adding the words in italics.

30. A notice may be served by the Association upon any member, either personally, or by sending it through the post in a prepaid letter addressed to such member at his registered place of abode *or by publication of such notice in the* JOURNAL *and forwarding a copy of the* JOURNAL *containing such notice, to such member, prepaid and addressed, as above-mentioned.*

Altered by Special Resolution, passed Aug. 2nd, confirmed Aug. 17th, and registered Aug. 31st, 1883, by adding the words in italics.

31. Any notice, if served by post, shall be deemed to have been served at the time when the letter *or a copy of the* JOURNAL containing the same would be delivered in the ordinary course of the post, and, in proving such service, it shall be sufficient to prove that the letter *or a copy of the* JOURNAL containing the notice was properly addressed and put into the post office.

WINDING UP.

32. The Association shall be wound up voluntarily whenever a special resolution, as defined by the Companies' Act (1862) is passed, requiring the Association to be wound up voluntarily.

NAMES, ADDRESSES, AND DESCRIPTIONS OF SUBSCRIBERS.

Dated the 17th day of August, 1874.

Witness to the above signatures.

BY-LAWS

OF THE

British Medical Association.

PASSED 17TH DAY OF AUGUST, 1883.

Election of Members.

1. Any qualified medical practitioner not disqualified by any by-law of the Association who shall be recommended as eligible by any three members may (subject as hereinafter mentioned) be elected a member by the Council, or by any recognised Branch Council, provided that the power of such Council or Branch Council shall only extend to the election of male persons.

2. No person shall be elected a member unless he has the votes of not less than three-fourths of the members present at the meeting of the Council or Branch Council at which he is proposed for election, and has agreed in writing to become a member, and to pay his subscription for the current year.

3. Any member may be expelled from the Association by a resolution of the Council if carried by three-fourths of the members present, subject to confirmation by the next annual meeting, and he shall thereupon cease to be a member and shall not be eligible for re-election. One month's notice of the intention to propose such resolution shall be given to any member affected thereby.

Subscription.

4. The subscription to the Association shall be one guinea *per annum*, which shall entitle each member to

the privileges of membership, and to receive the JOURNAL of the Association for the current year. The subscription shall date, and be considered due in advance, on the 1st of January in each year, except in the case of a member admitted on or after the 1st July, when the subscription for such part of a year shall be half a guinea in advance.

5. Any member whose subscription shall not have been paid on or before the 31st December of the current year shall be suspended from all privileges of membership; and, at the end of the succeeding year, if the arrears be still unpaid, he shall cease to be a member, and shall be ineligible for readmission until he shall have paid all arrears due at the period of his suspension. Any member wishing to withdraw from the Association shall give written notice of his intention to the General Secretary on or before the 1st December of the current year. On the 31st day of October in each year the Honorary Secretary of each Branch shall close the Branch account for the current year, and shall give notice that all unpaid subscriptions must be forwarded direct to the General Secretary of the Association. A notice of the annual closing of the Branch accounts shall be inserted in the JOURNAL during the month of October.

HONORARY MEMBERS.

6. Any person of professional or scientific eminence, and recommended by the Council, may be elected an honorary member at the annual meeting of the Association.

ANNUAL MEETING.

7. The date of the annual meeting shall be fixed by the Council; the place of meeting being determined prospectively in each year by the vote of the Association.

Officers.

8. The President of the Association shall be elected annually, at the annual meeting, and shall enter upon the duties of his office at the next annual meeting, and until then shall bear the title of President-elect. Each retiring President shall be eligible for election, by the Association in general meeting assembled, as a Vice-President, for life, provided that he continue to be a member of the Association. The President and President-elect shall be *ex officio* members of all Committees and sub-Committees of the Association.

9. The President of the Council shall be elected by the Council.. He shall hold office for three years; and at the first meeting of the Council after the determination of such office, a new President of Council shall be elected for the then ensuing three years; and every member who has served the office of President of the Council shall be eligible for election as a Vice-President of the Association, provided that he continue to be a member of the Association.

10. The Treasurer shall be elected at the annual meeting. He shall hold office for three years, and shall be *ex officio* a member of the Council, and every member who has served the office of Treasurer shall be eligible for election as a Vice-President of the Association for life, provided that he continue to be a member of the Association.

11. The Treasurer of the Association shall receive the subscriptions and other moneys payable to the Association, and discharge all accounts which have been ordered by the Council to be paid.

12. The Editor of the JOURNAL shall be elected by the Council, and be remunerated in such manner as the Council shall think fit.

13. The Secretary of the Association shall be elected by the Council. He shall reside in London, and devote

his whole time to the business and affairs of the Association and the office of the JOURNAL.

14. The duties of the Secretary shall include being present at the meetings of the Association and Council, the recording their respective minutes, the conducting of the correspondence of the Association; the superintending the collection of subscriptions; the enforcement of the regulations as regards those in arrear, and acting in general obedience to the directions of the Council.

15. The Secretary shall be remunerated in such manner as the Council think fit. The Editor and Secretary shall hold their respective offices during the pleasure of the Council, subject to receiving or giving (as the case may be) three months' notice to determine their respective appointments.

16. The offices of Secretary and Editor of the JOURNAL shall not be held by the same person.

COUNCIL.

17. The Council shall consist of the President, the President-elect, the President of Council, the Vice-Presidents of the Association, and the Treasurer (who shall all be *ex officio* members of the Council); and of members representing the Branches, who shall be elected as follows:—

(*a*) Every Branch shall be entitled to elect one representative member, and every Branch consisting of more than 200 members shall be entitled to elect an additional representative member for every complete 200 members of which it shall consist.

(*b*) The election of such member or members shall be annual, and he or they shall hold office from the second day of the annual meeting of the Association next after his or their election until the second day of the next following annual meeting.

(*c*) The return of the election of the representative member or members of each Branch shall be communicated in writing to the Secretary of the Association by

the President or Secretary of such Branch, not less than one month prior to the annual meeting of the Association.

(*d*) No person shall be eligible as a representative member "of a Branch within the limits of the United Kingdom of Great Britain and Ireland" unless, at the time of his election, he shall be resident within the area of the Branch nominating him as their member. "No person shall be eligible as a representative member of a Colonial or Indian Branch unless, at the time of his election, he shall be a recognised member of the Branch, and shall have resided within the area of the Branch for at least twelve months prior to his election. The election of Colonial and Indian Members of the Council shall be annual, and shall be subject to the same by-laws as the election of other representative members."

(*e*) In default of and until election by any Branch of a representative member or of representative members, or so far as such election shall not be complete, all the powers conferred on the Council shall belong to and be exercised by the *ex officio* members thereof alone or by the *ex officio* members and such representative members of the Council as may have been duly elected by any Branch or Branches, and of whose election return shall have been duly made as before mentioned.

(*f*) By-law (*e*) shall not take effect until the annual meeting in 1884; and, in the meantime, the Committee of Council in office at the time of passing these By-laws shall be the Council, and shall have all the powers conferred on the Council by the Articles of Association or the By-laws.

(*g*) Any casual vacancy occurring in the Council may be filled up by any Branch, the representation of which may have become vacant. The return of the election of a representative member by any Branch to fill a casual vacancy shall be communicated in writing to the Secretary of the Association by the President or Secretary of such Branch. But any person so chosen

shall retain his office so long only as the representative in respect of whom such casual vacancy may have occurred would have retained the same.

18. Notice shall be given forthwith to the Secretary of the Association by a Branch, of a representative having ceased to belong thereto; but until such notice shall have been received by the Council, no resolution or vote shall be deemed invalid by reason of a disqualified member taking part in its proceedings.

19. The Council shall annually prepare a report of the general state and proceedings of the Association for the past year, to be presented by them at each annual meeting of the Association.

20. The Council shall, at each annual meeting, propose the place of meeting for the next annual meeting, and nominate the President-elect.

21. A record of the attendance of each member of the Council at its meetings shall be kept and published annually in the JOURNAL.

22. The Council shall meet not less than four times a year and shall be presided over by the President of the Council, or in his absence by a chairman to be appointed by the meeting. Its meetings shall be held at such time and place as the Council shall appoint. Seven members shall be a quorum.

23. The President of Council may, if he think right, and upon receiving a requisition, signed by not less than ten members of the Council, and specifying the business for which a special meeting is required, shall call together a special meeting thereof, but at such meeting no business shall be transacted other than that for which such special meeting was called.

24. The Council shall manage the general affairs and business of the Association, except as otherwise provided by the Articles or By-laws. They shall also regulate the order of business, and shall nominate the readers of addresses at each annual meeting. They shall decide what shall constitute a section, and who shall preside over the same; and shall also arrange the

division into sections of the matters to be discussed and considered at such meeting.

25. The Council shall direct the publications of the Association, and shall take cognisance of any matter which may require immediate decision.

26. The Council shall at each meeting next after the annual meeting of the Association, appoint a public accountant to audit the accounts of the Association, and if directed by them, to prepare a balance-sheet, financial statement, and report, up to December 31st in each year. A financial statement shall be published in the JOURNAL within the first four months of each year.

27. In the event of the incapacity of any officer of the Association during his term of office, the Council may appoint any member to act for him. In the event of the death or resignation of the holder of any office, the holder of which is required to be elected by the Association at annual meeting, the Council may appoint a successor till the next annual meeting.

JOURNAL AND FINANCE COMMITTEE.

28. The Journal and Finance Committee in office at the time of passing these By-laws shall remain in office until the new Committee is formed as next hereinafter provided, and shall then retire.

29. At a meeting of the Council held next after the annual meeting, in 1884, a subcommittee of fifteen members of the Council shall be elected, who, together with the President, the President-elect, the President of the Council, and the Treasurer (who shall be *ex officio* members), shall constitute the Journal and Finance Committee. Three members shall form a quorum. The three elected members who shall have been longest in office shall retire annually ; and if, owing to any two or more having been in office for the same period there shall be any doubt as to which shall retire, the matter

APPENDIX TO BY-LAWS.

I.—Application for Admission and Agreement as to Terms of Membership.

I, residing at , am desirous of being elected a Member of the British Medical Association; and I agree, if elected, to pay the subscription, and to conform in all respects to the articles of Association, and to the By-laws now existing, or which hereafter may be made under or by virtue of the same.

Name.....

Professional title.....

Address.....

II.—Form of Certificate.

We, the undersigned, hereby certify that of is a fit and proper person to be elected a Member of the British Medical Association.

From personal knowledge or otherwise.

Signed { ..... | .... ; ..... | ..... ; ..... | .....

No. 2.—Form of Bequest.

Those persons who are inclined to benefit the Association by legacies are recommended to adopt the following.

I give and bequeath unto the British Medical Association the sum of £ ; such legacy to be paid out of such portion of my personal estate not specially bequeathed, as the law permits to be appropriated by will to such a purpose.

To the President of the *Branch*

of the British Medical Association.

Sir,

It is universally admitted that the British Medical Journal is at present ably edited, and that, while it is a great financial success, it is a repertorium of a vast amount of valuable scientific information.

At the same time it is believed by many members of the profession that the best interests and the honour of the Association would be greatly promoted by a change in the character of the Journal.

An opinion has for several years been widely held that the lines on which the Journal is now conducted, which are similar to those of proprietary Journals, with anonymous articles and reviews and multifarious advertisements, are not suitable for the organ of our Association, for the sayings and doings of which our members individually are responsible.

It is felt that the Journal should be a faithful exponent of the proceedings of the Association in all its departments, while presenting a record of contemporary professional work elsewhere; but that anything beyond this, whether articles, reviews, or annotations, should have the authors' signatures appended, as indicating the actual authority of the communications. The character of the advertisements also should be more carefully controlled than at present, and especially all announcements of secret remedies should be excluded.

It may be objected that such a change in the Journal would involve some pecuniary loss. But our members are now so numerous that the annual subscriptions, together with income from other sources, would cover all current expenses. And it may be remarked that our individual self-respect is a matter of higher moment than flourishing finances.

It is proposed, in the first instance, to address the Council of the Association requesting them to consider this important subject, and should it be deemed necessary, to summon a special general meeting in London. But before taking such a step it seems essential that there should be some guarantee that the proposed reform would be favourably regarded throughout the country. And we venture to ask that you will ascertain, as soon as may be, the feeling of your Branch upon the subject, and communicate the result to the Honorary Secretaries.

We remain,

Sincerely yours,

Joseph Lister.	J. E. Erichsen.
Joseph Fayrer.	Risdon Bennett.
J. Matthews Duncan.	Christopher Heath.
Robert Liveing.	William MacCormac.
Berkeley Hill.	Thomas Bryant.
John Langton.	Dyce Duckworth.
W. H. Broadbent.	

W. H. Allchin,
5, Chandos Street, Cavendish Square.
W. A. Meredith,
6, Queen Anne Street.
J. Williams,
11, Queen Anne Street.
Hon. Secs.

RAPPORTS

SUR LA

MÉTHODE DE TRANSFUSION DIRECTE

DE

VEINE A VEINE DU SANG HUMAIN

ENTIER ET VIVANT

Du Docteur J. ROUSSEL (de Genève),

Docteur de la Faculté de Paris,
Membre de plusieurs Académies et Sociétés de médecine,
Chevalier de l'Ordre I. de St-Wladimir de Russie,
de François-Joseph d'Autriche,
de Léopold de Belgique, etc.

Auteur du Transfuseur adopté par les Académies et Gouvernements de Russie, Autriche, Belgique, etc.

BRUXELLES,
LIBRAIRIE DE HENRI MANCEAUX,
IMPRIMEUR DE L'ACADÉMIE ROYALE DE MÉDECINE DE BELGIQUE,
8, Rue des Trois-Têtes, 8 (Montagne de la Cour).

1876

A. — Présenté par le professeur Soupart vice-président de l'Académie, M. le docteur Roussel de Genève, opère devant les membres, une démonstration pratique de la manœuvre de son transfuseur, sur le bras d'un homme robuste. Le sang jaillit en abondance de la canule terminale et tous les membres peuvent constater, qu'il est aussi pur et aussi vivant, que s'il sortait de la veine, que par conséquent si cette canule était introduit dans la veine d'un blessé, la transfusion s'accomplirait avec toutes les conditions de succès.

B. — **M. Roussel :** J'ai l'honneur de présenter à l'Académie de médecine un appareil pour opérer la transfusion directe de bras à bras, du sang vivant et intact. En 1865, j'ai fait avec cet appareil, datant de 1864, une très-heureuse transfusion dans un cas d'hémorrhagie puerpérale. En 1867, le dessin et la description du transfuseur furent insérés dans la *Gazette des hôpitaux* et les *Archives de médecine* de Paris ; mais il passa inaperçu, quoiqu'admis à l'Exposition de 1867, présenté au conseil de santé militaire, démontré au Congrès international par le docteur Jaccoud, et à l'Académie de médecine par le professeur Robin.

Ce silence est regrettable ; car pendant les guerres des dernières années on eût pu sauver des milliers de blessés, et la transfusion serait aujourd'hui une opération classique, au lieu d'être encore repoussée par un trop grand nombre de chirurgiens.

De 1864 à 1876, les principes de l'appareil et la méthode opératoire n'ont subi aucune modification ; la construction seule a été légèrement modifiée et améliorée par l'emploi

du caoutchouc durci au lieu d'argent. Ce progrès est considérable, car je pose en principe, par expérience, que tout contact de métal, comme du verre, de l'ivoire etc., est nuisible au sang et le dispose à la coagulation, qui devient même inévitable, si ce sang a été soumis un instant au contact de l'air.

Il en est de même du caoutchouc sulfuré, vulcanisé, gris ou noir du commerce, mélange d'une foule de substances étrangères dont les gaz et les poussières souillent et coagulent le sang. Mon transfuseur est entièrement composé de caoutchouc pur, naturel, non sulfuré, et de caoutchouc durci, corps neutre sans effet sur le sang, et dont le contact n'altère ni les tissus ni les liquides animaux.

I. — CONDITIONS DE LA TRANSFUSION.

Selon moi, les conditions absolues d'une bonne transfusion sont :

1) Que le sang soit de la même espèce animale et de la même source organique : de l'homme à l'homme, de veine à veine;

2) Qu'il demeure vivant et inaltéré dans sa composition la plus intime, n'ayant subi ni le contact de l'air ou de corps altérants, ni perdu son mouvement, sa température, ses gaz ou sa densité;

3) Que la quantité et la vitesse d'écoulement en soient au gré de l'opérateur;

4) Que l'opération soit sans danger pour les deux sujets.

Ces conditions n'ont jamais été ni posées ni remplies; C'est pourquoi la transfusion n'a point donné les résultats que l'on est en droit d'en attendre; que les tentatives d'opé-

ration ont été si souvent causes d'accidents considérables qui ont amené pour la transfusion un discrédit et un abandon immérité, et qu'une foule de savants dévoués se sont égarés à la recherche du moyen de faire à l'homme la transfusion de sang d'animaux, ou de sang artériel de l'homme, ou de sang défibriné et artificiel, ou de pratiquer la transfusion directe dite instantanée, dans laquelle le sang est un instant au contact de l'air.

Ma méthode et mon transfuseur remplissent, je le crois, complétement toutes ces conditions indispensables. Ils ont fait leurs preuves dans un nombre d'opérations très-heureuses.

Cette méthode de transfusion directe consiste :

1) A relier la veine qui donnera le sang à celle qui le recevra par un canal-moteur non interrompu, direct, plein d'eau ; donc vide d'air bien avant l'ouverture de la veine ;

2) A ouvrir ce vaisseau sous une couche d'eau, c'est-à-dire à l'abri de l'air, au moyen d'une lancette, de façon à avoir un jet de sang suffisant, par la simple piqûre de la saignée classique, évitant ainsi la phlébite que produit à coup sûr l'introduction et la ligature d'une canule dans la veine, comme avec les appareils de Maisonneuve et d'Aveling.

De l'eau. — L'eau qui remplit l'appareil au moment de la transfusion, et dans laquelle il a été plongé, malaxé et lavé, est à 20° ou 25°, afin d'éviter tout changement de température ou de densité dans le sang ; j'y ajoute quelques grammes de bicarbonate de soude, dans le but de bien purifier l'intérieur de l'appareil.

Cependant, en cas d'urgence, on peut se servir d'eau froide bien propre ; c'est ce que j'ai fait plusieurs fois sans aucun inconvénient. Cette eau ne sert qu'à chasser l'air

remplissant le transfuseur; elle ne pénètre pas dans la veine du malade, dans la transfusion simple.

Transfusion médicamenteuse. — Mais si l'indication en est donnée, on peut très-facilement mêler au sang, dans l'appareil lui-même, une certaine dose d'eau médicamenteuse en solution titrée.

Tranfusion électrisée. — On peut encore enfermer dans le transfuseur un courant d'électricité directe, et le conduire avec le sang jusqu'au contact du cœur lui-même, pour le réveiller dans le cas de mort apparente. Il suffit de lier le pôle positif d'un courant continu à la tige de la lancette, et de piquer les muscles respirateurs avec une aiguille d'acupuncture placée au pôle négatif.

II. — PRÉPARATION DE LA VEINE DE L'OPÉRÉ.

Chez un sujet anémié par hémorrhagie, la circulation superficielle est comme suspendue au profit des organes centraux. Les veines du bras ou de la jambe sont vides, aplaties, incolores et invisibles à travers la peau. Chez un anémique chronique, ces veines sont contractées, de petit calibre. C'est une erreur manifeste que de prétendre plonger dans de tels vaisseaux un trocart ou une aiguille canaliculée et de pénétrer sûrement dans de semblables vaisseaux, sans les percer d'outre en outre, et sans s'égarer dans leurs tuniques ou dans le tissu cellulaire ambiant. Se servir d'une lancette comme pour la saignée et introduire une canule dans la piqûre, est tout autant aléatoire; les plus habiles chirurgiens ont souvent manqué cette petite opération et poussé dans la gaîne une injection qui aurait dû pénétrer dans le vaisseau. Même sur un sujet dont la masse sang*uin*e

est intacte et dont on peut gonfler la veine par le lien circulaire de la saignée, il faut encore une pratique attentive et une dextérité particulière pour plonger un trocart dans la lumière du vaisseau. C'est là la partie difficile de l'injection intra-veineuse de chloral, cette nouvelle méthode d'anesthésie, qui méritait d'être sérieusement étudiée, puisqu'entre les mains habiles d'opérateurs belges et français, elle a, par de beaux succès, prouvé que le chloral a le droit d'être quelquefois préféré au chloroforme, malgré l'opposition des antagonistes trop violents, qui ont accusé la méthode d'accidents dont leurs mains seules me paraissent responsables.

Craignant pareille mésaventure, je demande que, pour accomplir une transfusion directe avec le succès opératoire que j'ai le droit d'attendre de mes collègues, puisqu'il ne m'a jamais manqué, on fasse une sérieuse préparation de la veine du sujet. Celui-ci est dans un état grave, puisqu'il a besoin d'une transfusion, et l'incision de la peau du bras dans une étendue de deux ou trois centimètres, les bords n'en dussent-ils pas même se réunir par première intention, est légère dans la balance, si de l'autre côté pèse la mort imminente.

S'arrête-t-il devant l'inconvénient de la plaie à faire à la peau du cou, le chirurgien qui doit sauver un enfant par la trachéotomie?

Pour pratiquer la petite opération que je propose, sans craindre ni thrombose, ni ecchymose, ni phlébite, ni hémorrhagie de retour, ni interruption du courant veineux ascendant; opération nécessaire à l'entière pénétration du sang transfusé, il faut faire un pli de la peau et l'inciser au bistouri, dans la direction de la veine, de façon à bien voir

celle-ci, mais sans la léser ni la dénuder; piquer la tunique externe avec une fine érigne ou tenaculum, et de la pointe de petits ciseaux courbes, inciser le vaisseau obliquement; on taille ainsi un petit lambeau en forme de V qui, restant soulevé par l'érigne, sert de guide et permet l'introduction certaine et inoffensive d'une canule mousse que l'on pousse à deux centimètres dans la veine. Le doigt d'un aide, posé en travers sur le milieu de la canule, la fixe et clôt la petite porte que forme le lambeau retombant à sa place après la transfusion.

Si l'invisibilité de la veine a exigé une incision un peu longue, une épingle à suture passée dans la peau en assurera l'occlusion et sa cicatrisation par première intention.

Je choisis d'ordinaire une des veines du bras, ce qui est plus commode; mais sur un sujet délicat, on peut se servir d'une saphène qui, étant plus loin du cœur et du poumon, fait que l'impression du jet de sang transfusé est moins sensible pour ces organes.

Si la transfusion était nécessitée par une hémorrhagie résultant d'une amputation, elle pourrait être faite directement dans une des veines du moignon.

Il va sans dire qu'avant de penser à la transfusion, le chirurgien a déjà tari, autant que possible, la source de l'hémorrhagie.

Ischémie temporaire. — Si le sujet a été relevé sur le champ de bataille, exsangue, en syncope et paraissant mort, mais non encore envahi par la rigidité cadavérique, il ne faut pas chercher à le réveiller de cette syncope qui a suspendu la perte des dernières gouttes de sang. Il faut pratiquer l'ischémie temporaire avec l'appareil d'Esmarch, non-seulement sur le membre blessé, mais sur les

bras et jambes exempts de lésions, depuis l'extrémité jusqu'à la racine, pour repousser vers les organes centraux le sang actuellement inutile dans les membres.

On tend ainsi à relever l'équilibre hydrostatique rompu par l'hémorrhagie ; puis on délie les membres, les uns après les autres, pendant la transfusion, afin de permettre au sang nouveau de se répandre dans tout l'organisme.

Saignée déplétive. — Au contraire, s'il s'agit d'un asphyxié, d'un noyé ou d'un empoisonné, il faut pratiquer une large ouverture à la veine, même à l'artère du bras opposé, afin de faire de la place au sang nouveau, d'éliminer le plus possible de sang altéré et de permettre au cœur, dans les cas de mort apparente, des battements plus faciles, conséquence naturelle de la section d'une artère.

III — DESCRIPTION DU TRANSFUSEUR.

Le transfuseur se compose d'un ballon-moteur (14) de caoutchouc élastique servant de pompe aspiratrice du sang de la veine de l'un des sujets pour l'introduire dans celle de l'autre, par un mouvement non interrompu afin d'éviter le moindre arrêt du sang. Ce ballon ovale, d'une fabrication minutieuse, est parfaitement poli à l'intérieur, sans aucune aspérité qui puisse favoriser la coagulation. Il contient 10 grammes de sang, ce qui permet de mesurer très-exactement la quantité transfusée, d'après le nombre des mouvements du ballon.

Il est dans la main du chirurgien, qui peut ainsi apprécier la résistance offerte par l'organisme transfusé et précipiter ou ralentir le cours du sang selon les indications.

Ce ballon-moteur aspire le sang par l'intermédiaire d'un

cylindre (11) rigide, appliqué sur la peau. Pour fixer ce cylindre de façon que l'air ne puisse jamais y pénétrer, je l'ai entouré d'une sorte de coque rigide qui devient une ventouse (10) animée par un ballon spécial (9).

Cette ventouse annulaire, qui est une conception absolument originale, est pourtant la cause du silence qui s'est fait pendant dix ans autour de mon transfuseur. Lorsque la *Gazette des hôpitaux* en donna la description, un fabricant, qui voudrait passer pour l'auteur de tous les instruments de chirurgie passés, présents et futurs; sans avoir compris, ni même vu mon appareil, publia dans le même journal cette réclamation : « moi, Mathieu, j'ai inventé, il « y a longtemps, un appareil à transfusion commençant « par une ventouse, et c'était un mauvais appareil; le doc- « teur Roussel invente une ventouse : donc c'est ma ven- « touse qu'il copie; donc ce n'est rien de bon etc. » On le crut sans examen; il était influent alors, mais depuis..... Bien d'autres que moi ont eu à repousser ses injustes revendications — moi, j'ai perdu dix ans. — Les prétendues ventouses de Mathieu, de Moncoq et d'autres sont des élargissements du tube d'entrée pour le sang, élargissements qui s'appliquent sur la veine ouverte, et qui cessent de faire la ventouse puisqu'ils se remplissent de sang. Ce liquide se coagule très-vite dans une ventouse; Mathieu a eu raison de dire que son appareil était mauvais.

Ma ventouse est un manchon en dehors du transfuseur; ni le sang, ni l'eau, ni l'air ne peuvent y pénétrer; elle sert de pied à l'appareil et le fixe sur la peau.

Le cylindre initial est ouvert par en haut, ce qui permet de choisir et de voir très-exactement le point à saigner qu'il doit envelopper.

Quand, au moyen de la ventouse, l'appareil est en place sur le bras du donneur de sang, on ferme le cylindre par l'introduction du porte-lancette (12).

Cette lancette est montée sur un curseur à vis millimétrique (13), au moyen de laquelle on règle mathématiquement la pénétration de cet instrument, d'après l'épaisseur de la peau à traverser, le diamètre et la profondeur de la veine, qu'il ne faut pas craindre d'ouvrir largement.

Cette veine sera une médiane large et bien fixée dans le tissu cellulaire, un peu au-dessus du pli du coude à l'endroit où elle commence à devenir profonde.

La direction de la lame est modifiée au gré du chirurgien au moyen de deux points métalliques fixés à la tête de la lancette.

Mais le transfuseur est encore plein d'air; si le sang y était introduit, il s'y altérerait, ainsi qu'il arrrive dans les hématophores Moncoq, Maisonneuve et Aveling, partant à chaque bout des canules ou trocarts introduits dans les deux veines.

Pour chasser cet air, il faut remplir d'eau le tranfuseur, en plongeant le tube aspirateur (7) dans un vase à eau chaude (6). C'est là un des côtés de mon invention.

Cette eau remplit le cylindre, baigne la peau et la lancette; elle s'avance dans le ballon ovale et sort par les canules finales, en poussant devant elle l'air intérieur.

Ces canules, de caoutchouc durci, sont de diamètres différents; pour s'adapter au calibre des veines anémiques, il faut, autant que possible, préférer la plus grande (16), que l'on introduit fermée et pleine d'eau, dans la veine préparée, à l'avance.

Entre les deux canules se trouve un robinet à bifurcation

qui ferme l'une en ouvrant l'autre, et laisse s'écouler au dehors l'eau contenue dans le transfuseur.

Pas de ligature autour de la veine contenant la canule : le doigt d'un aide suffit pour la fixer et prévenir le reflux du sang.

La petite goutte d'eau, que contient la canule fermée dans la veine, est indispensable; elle empêche toute introduction d'air, bien mieux que le mandrin d'un trocart ; de plus, elle éloigne le sang de l'opéré, sang qui pourrait se coaguler en se trouvant en repos et au contact d'un corps étranger.

A ce moment, le blessé et le donneur de sang sont réellement réunis par un canal hermétique, direct, plein d'eau, vide d'air.

C'est alors que le chirurgien ferme le tube aspirateur d'eau et ouvre la veine par un coup sec donné sur la tête de la lancette.

Le sang jaillit dans le cylindre plein d'eau, qu'il chasse devant lui, comme celle-ci avait chassé l'air; cette eau sort par la bifurcation avec les premières gouttes de sang dilué, et quand ce liquide apparaît pur à la bifurcation, il suffit de tourner celle-ci pour le conduire dans la veine du blessé.

Le ballon-moteur envoie dans la veine de l'anémié, au fur et à mesure qu'il le puise dans la veine turgide, du sang dont chaque parcelle n'est restée que moins d'une seconde hors du vaisseau humain, enfermée dans un tube plein.

Ce sang est conduit par une veine et un cœur artificiels hermétiquement clos, humides, chauds et mous comme les vaisseaux, loin du contact de tout corps altérant.

Ce sang n'est modifié ni dans sa fibrine, ni dans ses globules ; il n'a perdu ni ses gaz, ni sa température, ni sa

densité. Il passe d'un organisme à l'autre avec toute sa vitalité première. Il continue à vivre, en produisant chez le malade tous les effets qu'il produirait chez l'homme vigoureux qui l'a fourni.

Doses de la transfusion. — Pour n'être ni en excès, ni insuffisante, une bonne transfusion, chez un adulte anémique, doit lui fournir de 200 à 300 grammes de sang.

On s'arrêtait jadis à des doses moindres, à cause du mauvais fonctionnement des divers hématophores : seringues ou clysopompes employés; il arrivait même qu'avec 60 grammes on produisait des accidents formidables.

On dépasse cette dose avec l'aveugle transfusion artérielle du sang de mouton, qui, à peine introduit, s'élimine au milieu d'un douloureux cortége de phénomènes perturbateurs.

Pour n'engorger ni le cœur, ni le poumon de l'opéré, il faut ne lui donner que 60 à 80 grammes par minute, soit moins d'un gramme par diastole du cœur, quantité modérée qui rend à l'organe anémique le point d'appui mécanique de ses mouvements, et qui en arrivant graduellement au cerveau, ranime et entretient l'excitabilité physiologique nécessaire aux fonctions vitales.

Si un coopérateur habile se charge de la préparation de la veine anémique et de l'introduction de la canule, une bonne transfusion peut, en 8 à 10 minutes, rendre à un exsangue assez de sang pour le rappeler à la vie.

L'opération est précise et facile, après étude du transfuseur et ses résultats sont héroïques.

Phénomènes succédant à la transfusion. — Pendant l'opération le transfusé est resté calme; s'il était en syncope le cœur recommence à battre et le poumon à respirer; la face et la poitrine, qui sont découvertes sous les yeux de

l'opérateur, se sont colorées et humectées d'une légère sueur naissant à la racine des cheveux. Le long du bras, jusque sous l'aisselle, on voit la veine se gonfler comme par une pulsation à chaque mouvement du ballon-moteur.

L'opéré accuse dans ce bras un courant de chaleur qui gagne vite la poitrine, la face, la tête et le corps entier.

Le pouls et la respiration sont devenus amples et profonds ; vers la fin de l'opération, il peut y avoir une très-légère dyspnée, avec cyanose et un peu d'excitation.

Le bras étant ensuite bandé et replacé dans le lit, il est bon d'avertir le malade qu'il aura un frisson, et qu'il doit ingurgiter de suite un grand verre de boisson chaude et alcoolisée (thé au rhum).

Le frisson commence 20 minutes après la transfusion; il dure 30 minutes et il est quelquefois violent, mais jamais excessif. C'est une sorte de frisson de digestion du sang nouveau; c'est l'action du système vaso-moteur distribuant dans tout l'organisme le sang qui vient de distendre les veines. Le frisson est suivi d'un stade de sueur abondante et de chaleur générale pendant lequel le malade s'endort.

Il dort pendant une ou deux heures, la face un peu vultueuse, le pouls et la respiration animés. La température, qui avait baissé à la peau pendant le frisson, pour se concentrer et s'élever dans le rectum, s'équilibre et devient normale. Au réveil se manifeste un pressant besoin d'uriner et d'aller à la selle, puis le grand désir de manger.

L'urine n'est ni sanguinolente, ni albumineuse, si elle ne l'était pas auparavant; mais elle est abondante, odorante, jaune paille et chargée de sels normaux.

Les selles sont abondantes, souvent anciennes ; elles indiquent le réveil d'un organe paresseux.

C'est le moment de changer le lit du malade, de visiter le pansement du bras opéré, et de se féliciter tous ensemble du bonheur commun. Il faut donner à manger à l'opéré qui le demande, l'encourager à boire encore un cordial. C'est le commencement de la guérison.

Bientôt il s'endort de nouveau pour plusieurs heures, et son sommeil est calme et réparateur. Au réveil, il demande encore à manger. Si tout est bien, la respiration doit être ample et facile, le pouls plein, la peau chaude et moite, l'intelligence entière.

Bien rarement on a observé à ce moment un peu d'abattement; un excellent excitant moral ou physique, un verre de vin de Champagne, par exemple, aura bientôt relevé les forces.

Depuis ma trop récente arrivée en Belgique, je n'ai pas encore eu l'occasion de faire la transfusion, malgré la bonne volonté des divers chefs de services hospitaliers; je suis heureux de pouvoir les remercier publiquement de leur bon accueil. Je regrette de n'avoir pas sous la main quelques bonnes occasions d'opérer; mais je crois ne pas devoir compromettre ma méthode naissante en l'employant sur des sujets manifestement incurables, à cause de la diathèse ou de la lésion d'un organe important dont ils sont atteints.

Je n'ai pas ici à prendre la défense de la transfusion; chacun admet que du sang transfusé peut empêcher un homme exsangue de mourir.

Quant aux autres indications, elles se présenteront naturellement lorsqu'on aura adopté une bonne méthode opératoire.

C'est donc simplement une méthode et un *modus faciendi*

nouveau que j'ai l'honneur de présenter à l'Académie. J'espère que, par les démonstrations que j'ai faites ici et ailleurs sous vos yeux avec du sang humain, pris sur le bras de gens dévoués, j'ai pu vous prouver que le sang traverse mon transfuseur, en conservant sa fibrine, ses globules, sa température, ses gaz et sa densité; qu'il jaillit de la canule finale aussi pur et vivant que de la veine elle-même, et qu'il est très-facile de le conduire en cet état, en quantité voulue et avec une vitesse connue dans la veine de l'opéré; enfin, que je ne prends à l'homme dévoué que la quantité que je veux donner au malade, et que je la prends par une simple saignée classique, par conséquent tout à fait inoffensive.

C'est là seulement ce que je voulais soumettre à votre appréciation.

Aux médecins qui montrent quelque hésitation à adopter ma lancette cachée et son mouvement mécanique, je ferai observer que c'est là le seul procédé possible si l'on veut être absolument certain que le sang ne sera pas au contact de l'air, ni avant, ni pendant la transfusion; pour moi cela est un point capital, et c'est la seule manière d'être à l'abri de toute cause de coagulation et de toute déperdition du précieux liquide.

Je pourrais pratiquer la saignée à la main et fixer sur elle le cylindre enveloppé de sa ventouse; mais, sauf la phlébite, je ferais la même faute que ceux qui introduisent une canule dans la veine. Même en remplissant l'appareil d'eau, au premier jet, le sang se trouverait au contact de l'air, qui, en le faisant adhérer aux parois du tranfuseur, l'exposerait à se coaguler en partie.

Du reste, en s'éloignant de l'artère, et en observant la marche de la lancette, on ne court aucun risque. On

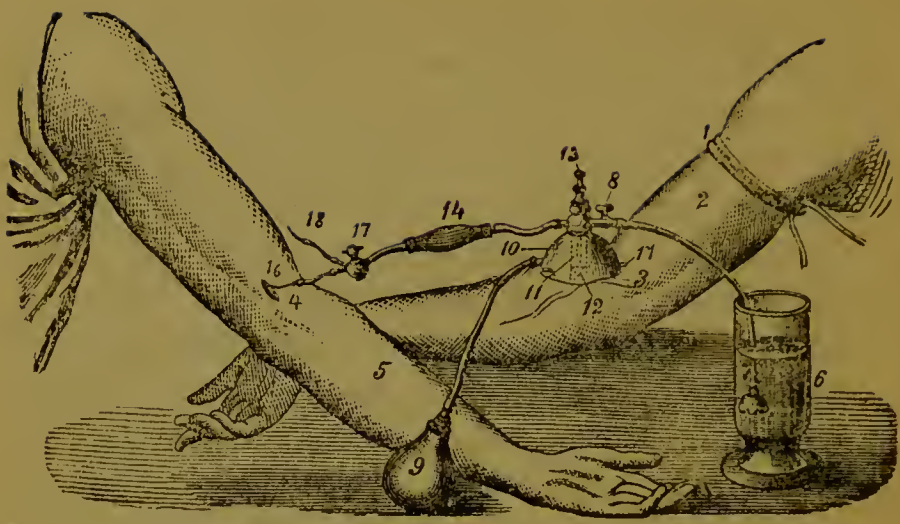
pourrait par excès de prudence, allonger successivement la lancette sur place et disséquer couche par couche; mais il est mieux de piquer hardiment une veine de grand calibre, et arrivât-il même qu'elle fût transpercée, ce que je n'ai jamais vu, il n'y aurait là qu'une plaie absolument insignifiante, eu égard au grand but à atteindre.

Aux partisans du sang défibriné, je répondrai qu'il n'y a pas de parallèle à faire entre deux choses différentes. Ils ne font pas de *transfusion de sang*, car transfusion signifie le passage du sang d'un corps dans l'autre, *sans interruption de courant;* or leur liquide artificiel n'est plus du sang, et leurs deux sujets ne sont pas réunis. Pour employer des termes vraiment scientifiques et grammaticaux, ils doivent dire qu'ils pratiquent l'injection intra-veineuse d'un liquide médicamenteux préparé avec du sang.

Ils soulèvent la difficile question du meilleur liquide artificiel à injecter dans les veines : sera-ce le sang défibriné, simple ou additionné d'un sel? Sera-ce du sérum artificiel pharmaceutique ou de l'eau albumineuse, ou de l'eau alcoolisée, ou simplement du lait?

Ces études se font actuellement dans les laboratoires de physiologie d'Allemagne, d'Angleterre et d'Italie; elles ont leur importance, et je suis loin de vouloir en faire la critique; je me déclare pour cela incompétent.

Je me restreins à la transfusion directe du sang humain vivant, seule opération à laquelle j'accorde ma confiance, bien justifiée, je pense, par les bons résultats que j'en ai obtenus dans les nombreuses recherches auxquelles j'ai consacré la plus grande partie de mon temps.



1. Bande pour la saignée.
2. Bras qui donne le sang.
3. Veine turgide à saigner.
4. Veine du blessé préparée.
5. Bras qui reçoit le sang.
6. Vase contenant de l'eau.
7. Cloche de l'aspirateur d'eau.
8. Robinet fermant l'aspirateur.
9. Ballon rond de la ventouse.
10. Enveloppe externe de la ventouse.
11. Cylindre interne de la ventouse.
12. Lancette intérieure du cylindre.
13. Curseur régulateur de la lancette.
14. Ballon-pompe du transfuseur.
16. Canule introduite chez le blessé.
17. Robinet de la bifurcation.
18. Canule rejetant l'eau en dehors.

M. Burggraeve obtient la parole au sujet de cette communication. Il fait d'abord remarquer que la question qu'elle soulève est extrêmement importante. M. Roussel ne défibrine pas le sang; or, selon M. Burggraeve, c'est une question de vie ou de mort.

Il rappelle que dernièrement on a fait à Gand, la transfusion de sang défibriné, au moyen de l'appareil de M. Casse, qui est très-simple, et que cette opération, pratiquée sur une personne qui ne donnait presque plus signe de vie, par suite d'une hémorrhagie occasionnée par un accident de chemin de fer, a parfaitement réussi.

M. Burggraeve est d'avis, qu'il y a du danger à introduire du sang non défibriné dans la veine d'un individu, des caillots pouvant se former dans les vaisseaux où ils sont entraînés, et produire des embolies très-compromettantes pour le patient.

Que faut-il, ajoute l'honorable membre, pour ranimer une personne anémiée? Il faut introduire dans les veines des globules rouges, ces éléments seuls pouvant répandre dans l'économie l'oxygène qui y est nécessaire. La fibrine est inutile, selon lui, et peut constituer un grave danger. Il faut donc, à son avis, l'extraire préalablement du sang à transfuser.

A l'appui des considérations présentées par M. Burggraeve, M. Thiernesse fait observer que, dans le procédé de transfusion de M. Roussel, il faut tenir compte, non-seulement des inconvénients signalés par son honorable collègue de Gand, mais encore de cette circonstance, qu'on infuse du sang veineux, partant très-impur, et dont les globules, dépouillés d'oxygène et imprégnés d'acide carbonique, ne peuvent ranimer l'organisme. Pour atteindre le but, il

faut nécessairement, dit-il, que ces éléments anatomiques soient aussi oxygénés que possible, et c'est ce qu'on obtient naturellement en défibrinant le sang à infuser.

M. Roussel répond que son but a seulement été de soumettre à l'Académie le nouveau transfuseur qu'il a imaginé, et de lui démontrer que, au moyen de cet appareil, la transfusion de veine à veine se fait facilement et sans danger, le passage rapide du sang de la veine dont on l'extrait dans celle de la personne qui le reçoit, ne permettant pas, selon lui, qu'il s'y forme le moindre caillot.

Il n'entend pas discuter en ce moment la question des avantages et des inconvénients de ces deux modes : la transfusion directe de veine à veine, et celle du sang préalablement défibriné ; mais il ne peut admettre que la fibrine soit inutile dans ce liquide organique, et il persiste à penser qu'il est préférable de transfuser le sang non dépouillé de cette matière, constituant le sang normal.

Il ne croit pas non plus que le sang veineux puisse être appelé du sang très-impur, comme le dit M. Thiernesse, et inférieur liquide manipulé par la défébrination. Le sang veineux est normal, possédant des qualités spéciales nécessaires à la vie et pour le contact duquel la moitié entière de notre système circulatoire est spécialement construite.

Puisque c'est dans une veine seulement que doit se faire la transfusion, c'est du sang veineux entier et vivant qu'il est logique d'y conduire.

(Extrait des *Archives médicales belges.*)

La transfusion; première série, trente-cinq opérations; *par M. le docteur* J. Roussel (*de Genève*). Librairie P. Asselin, 1876.

M. le docteur Roussel, appelé par M. le Ministre de la Guerre, sur l'avis favorable de M. l'Inspecteur général du service de santé, pour faire des démonstrations pratiques avec l'appareil à transfusion, dont il est l'inventeur, a tenu, à l'hôpital militaire de Bruxelles, deux séances, auxquelles ont assisté un grand nombre de médecins militaires, parmi lesquels nous citerons M. l'Inspecteur général, docteur Fromont, et la plupart de nos médecins principaux, MM. Dechange, de l'hôpital de Gand, Lelong, de l'hôpital de Bruxelles, Legros, de l'hôpital d'Anvers, Raymond, de l'hôpital de Liége, Dewalsche, attaché à l'inspection générale.

Mais avant de parler de ces séances, nous parcourrons rapidement l'ouvrage dont nous avons transcrit le titre ci-dessus.

Après quelques pages d'introduction, consacrées à l'historique de la question, l'auteur nous donne, en six séries, la relation aussi sincère que complète de trente-cinq opérations veinoso-veineuses de transfusion faites, à l'aide de son appareil, de l'homme à l'homme.

La première série comprend six opérations pour maladies diverses : hémorrhagie puerpérale, hémorrhagie par fibrome utérin, inanition, anémie, scorbut, tétanos; cinq succès.

Deuxième série : Cachexies par suppuration prolongée; sept opérations, trois succès.

Troisième série : Brûlures étendues; deux opérations, demi-succès.

Quatrième série : Anémie chronique (sous la dépendance d'un état nerveux mental); quatre opérations, deux succès.

Cinquième série : Anémie par cachexie (scorbut, leucocythémie, albuminurie, tuberculose); cinq opérations, quatre succès.

Sixième série : Anémie par affections intestinales (dothiénentérie, entérite); quatre opérations, deux succès.

Ces résultats sont remarquables, si l'on songe que toutes ces opérations ont été pratiquées dans des cas d'une haute gravité, un grand nombre même dans des cas désespérés. Bien plus, il est à noter que jusque dans les cas d'insuccès, dus indistinctement aux progrès du mal et nullement à l'opération, la transfusion a produit une amélioration passagère et prolongé incontestablement la vie de quelques heures, de quelques jours, de quelques semaines.

Nous ne dirons rien de la transfusion artério-veineuse et artério-artérielle de l'homme à l'homme, ni de la transfusion directe (artério-veineuse, artério-artérielle) du sang de l'animal (mouton) à l'homme. Toutes ces méthodes, l'auteur les condamne comme dangereuses, les dernières surtout qui provoquent invariablement des symptômes d'engorgement des vaisseaux de la moelle allongée et d'irritation des méninges cérébro-spinales; puis des phénomènes consécutifs d'élimination du sang transfusé (congestion rénale, hématurie, exanthèmes variés : purpura, urticaire, etc.), preuve évidente de la répugnance de l'organisme humain à conserver le sang animal.

La transfusion, telle que la pratique M. le docteur Roussel, c'est-à-dire la transfusion directe, veinoso-veineuse, de l'homme à l'homme, s'achève, au contraire, sans le moindre trouble chez l'opéré. Un frisson, survenant environ vingt minutes après l'opération, une légère élévation de la température (un demi à un degré) et du pouls (dix à quinze pulsations), et une transpiration plus ou moins abondante, suivie d'un sommeil calme et réparateur; tels sont les phénomènes uniquement mais invariablement observés. Au réveil, l'opéré a ordinairement une selle normale et évacue une grande quantité d'urines limpides, sans aucune trace d'albumine, de globules ou autres matières du sang.

Les *contre-indications* de la méthode existent d'une manière générale dans la diminution de la résistance normale des tissus du système circulatoire, que cette altération réside d'ailleurs dans le cœur, les gros vaisseaux, ou dans les capillaires (cerveau, poumons, reins, etc.).

Quant aux *indications*, elles sont nombreuses et peuvent se diviser en six classes. Ainsi le sang transfusé est :

1° Un *modificateur des quantités*, soit de la masse totale du sang (hémorrhagie), soit des globules rouges (hypoglobulie), soit du plasma sanguin (choléra, vastes brûlures).

2° Un *modificateur des qualités* du sang vicié soit par une maladie organique (leucocythémie), ou par des suppurations abondantes ; soit par une diathèse (scorbut, scrofulose) ; soit par des substances étrangères (poisons, virus, venin, asphyxie, etc.).

3° Un *modificateur des actions nerveuses* (névroses dépendant d'anémie profonde, fièvres dites sine materia, tétanos, etc.).

4° Un *aliment héroïque* chez tous les sujets profondément débilités par une maladie constitutionnelle ou organique.

5° Le *véhicule le plus intime d'un médicament*, pour introduire dans les veines, à l'abri de l'air, un liquide médicamenteux en même temps que le sang. Cette opération, que l'auteur appelle *transfusion infusoire*, est particulièrement indiquée dans le choléra, les brûlures étendues, comme aussi dans les empoisonnements graves du sang (morve, rage, etc.). Dans ce dernier cas, la transfusion sera précédée d'une saignée déplétive.

6° Le *meilleur conducteur d'un courant électrique dirigé au cœur*, dans tous les cas de mort apparente par hémorrhagie, asphyxie ou empoisonnement. C'est la *transfusion électrisée*.

Etudiant ensuite les conditions que doit remplir un appareil de transfusion, le distingué praticien de Genève prouve avec infiniment de bon sens et de talent qu'un appareil de cette nature, pour être irréprochable, doit ne pas nuire à celui qui offre son sang, comme à celui qui le reçoit, permettre d'introduire et de mesurer la quantité de sang à transfuser, et surtout en empêcher la coagulation, condition *sine qua non* qui prime toutes les autres. Partant de ces principes, l'auteur adresse des reproches sérieux à tous les appareils connus jusqu'ici, et qui tous, pour ne parler que d'un de leurs nombreux inconvénients, contiennent dans leur construction des métaux, de l'ivoire, du verre, du bois, du cuir, du caoutchouc sulfuré: substances qui retiennent le sang à leur surface et produisent un effet rapide de coagulation.

A tous ces points de vue, l'appareil Roussel est celui qui se rapproche le plus de l'idéal désiré. Il est entièrement construit de caoutchouc naturel neutre, sans effet sur le sang, et se compose des diverses pièces représentées par la figure (v. p. 18).

Avant d'aller plus loin, et afin de faire mieux comprendre le manuel opératoire, nous ferons observer ici que la ventouse 10, munie de son ballon rond 9, peut être considérée comme un appareil tout-à-fait indépendant du transfuseur proprement dit ; c'est, si l'on veut, une annexe, qui a pour but unique de fixer et de maintenir le cylindre interne 11 sur la veine du donneur de sang. Le mécanisme en est du reste trop simple pour que nous croyions devoir nous y arrêter.

Il faut choisir pour donneur de sang un homme ou une femme adulte robuste et sain, dont le bras soit bien musclé, à peau résistante, sous laquelle on puisse faire gonfler des veines larges, peu saillantes et bien fixées dans le tissu cellulaire. La veine préférable est la médiane, après la bifurcation un peu au-dessus du pli du coude, à l'endroit où elle commence à devenir profonde. La ventouse doit être placée de façon à ce que son bord, tourné vers la main du donneur de sang, repose sur la partie la plus profonde de la veine, sans la comprimer, et que, le cylindre intérieur étant ouvert par le haut, laisse voir à son centre le point à saigner, que l'on a marqué d'un trait de plume ou crayon.

Un bras maigre à peau fine, dont les veines sont trop saillantes, mobiles et noueuses doit être repoussé.

Quant au porte-lancette 12-13, il est mobile et s'enlève pour mieux préciser l'application de la ventouse ; le curseur régulateur 13, comme l'indique son nom, sert à régler la saillie à donner à la lancette, c'est-à-dire la profondeur à laquelle on désire piquer la veine ; il est muni de deux yeux métalliques dont le plan joignant est invariablement parallèle à celui de la lame de la lancette ; de cette façon la direction de cette dernière est toujours connue.

Le ballon-pompe 14 est muni à ses deux extrémités d'une soupape dont le jeu transforme le ballon en pompe aspirante et foulante. Le

robinet 17 commande les deux cannules 16 et 18, de telle façon qu'en ouvrant l'une il ferme l'autre.

Le *Manuel opératoire* comprend tout d'abord la préparation des bras du blessé et du donneur de sang, préparation fort simple chez ce dernier et consistant uniquement dans l'application du bandage de saignée, mais fort délicate chez le premier, dont une veine mise à nu par la section d'un pli de la peau, est piquée d'une érigne, incisée en V et refermée momentanément.

Le transfuseur baigne dans une cuvette d'eau chaude à 30°, additionnée de demi pour mille de bi-carbonate de soude.

Ceci étant, on applique la ventouse et l'on ferme le cylindre en introduisant le porte-lancette, que l'on tourne à son gré pour donner à la lame la direction voulue sur la veine ; l'appareil est alors en place.

Quittant la ventouse, le chirurgien plonge dans l'eau la cloche du tube d'aspiration, et, prenant de la main gauche le ballon ovale moteur du transfuseur, il le comprime et le relâche alternativement sous les doigts rassemblés. L'eau monte dans le tube, remplit le cylindre, le ballon et la canule, chassant devant elle l'air contenu dans l'appareil. C'est en ce moment que l'opérateur soulève le lambeau en V fait à la veine du blessé, pour y introduire, de deux centimètres environ, la canule remplie d'eau, que le doigt d'un aide maintient fixée dans cette position ; il tourne ensuite le robinet de la bifurcation, qui ferme la canule et ouvre le tube latéral.

Revenant à la ventouse, le chirurgien ferme le tube à eau et frappe la tête de la lancette d'un coup sec et rapide du bout des doigts réunis ; continuant la manœuvre du moteur, l'opérateur voit sortir par la bifurcation finale de l'eau pure, puis de l'eau rougie, puis du sang pur. De même que l'eau avait chassé l'air, le sang jaillissant de la veine chasse l'eau, et quand il se présente pur à la bifurcation, il suffit d'en changer la direction pour le conduire dans la veine du blessé.

C'est alors que commence la transfusion par la pression et le relâchement alternatifs du ballon ovale, lentement et régulièrement 6 à 8 fois par minute, en comptant haut le nombre des battements du moteur.

Chaque battement de ce cœur artificiel donne 10 grammes de sang,

soit 60 à 80 grammes par minute, soit 1 gramme par battement du cœur du blessé.

20 à 25 mouvements du ballon-moteur envoyant 250 grammes de sang, en quatre minutes, sont la dose nécessaire et suffisante à une bonne transfusion.

L'opération finie, le chirurgien retire la canule de la veine et bande le bras du blessé (si la préparation de la veine a nécessité une longue incision de la peau, il est bon d'y passer une ou deux épingles).

La ventouse se détache du bras par la simple pression du ballon rond, le bras reçoit le bandage de la saignée; il sera guéri le lendemain, sans le moindre dommage pour l'homme qui se sera dévoué.

Nous avons parlé plus haut de *transfusion infusoire* et de *transfusion électrisée*. Pour la première de ces opérations on laissera ouvert le tube à eau, qui doit porter au sang la solution médicamenteuse; pour la seconde, le manuel opératoire n'est en rien changé; il exige seulement un appareil électrique à courant constant, dont le pôle positif est enroulé autour de la tige de cuivre de la lancette, et dont le pôle négatif, se terminant par une aiguille d'acupuncture, est piqué dans les muscles respirateurs, ou dans le voisinage du nerf grand sympathique. Nous avons dit un appareil à courant constant, l'auteur en effet, fait observer que les courants d'induction produisent une contracture tétanique du cœur, c'est-à-dire un résultat tout-à-fait opposé à celui cherché.

L'ouvrage de M. le docteur Roussel se termine par un appendice contenant une critique fort judicieuse des diverses méthodes et des divers appareils de transfusion, puis quelques mots relatifs *a*) à l'hydrostatique appliquée à la transfusion, *b*) à l'injection d'eau dans les veines à défaut de transfusion, *c*) à l'ischémie temporaire comme adjuvant de la transfusion, *d*) à la transfusion sur le champ de bataille. Viennent ensuite les conclusions de l'auteur, suivies de deux pièces officielles : un rapport au ministre de la guerre d'Autriche-Hongrie, signé Neudörfer, et un rapport au ministre de la guerre de Russie, signé Heyfelder, à la suite desquels le transfuseur Roussel a été adopté dans ces deux pays.

Tel est le travail que M. le docteur Roussel livre aujourd'hui à l'examen du public médical, en même temps que le modèle perfectionné d'un appareil, qui fut imaginé et construit pour la première fois, à Genève, en 1864 ; travail consciencieux qui contient sur la question de la transfusion, un peu partout à l'ordre du jour en ce moment, tous les éléments d'appréciation désirables ; appareil ingénieux, que l'on est tenté d'appeler parfait, tant il tient compte de toutes les lois physiques et physiologiques qui interviennent dans l'opération pour laquelle il a été créé, tant il répond à toutes les exigences de la transfusion.

Nous ne lui ferons que deux objections, tout-à-fait accessoires du reste, et que l'auteur voudra bien nous pardonner en raison même de l'intérêt que nous portons à son appareil : la première, essentiellement pratique, dans la délicatesse de la préparation de la veine du blessé, délicatesse peu compatible avec le brouhaha du champ de bataille, et que les chirurgiens russes ont fait ressortir en adoptant une pince-trocart (1), pour éviter l'incision en V de la veine ; la seconde, complétement du domaine de la théorie, dans la présence de la lancette dans le courant sanguin, inconvénient que l'on comprendra d'autant mieux que l'auteur insiste davantage sur la propriété du métal de favoriser la coagulation du sang. Dans ces conditions, la lancette est un véritable point noir, que l'auteur n'est point parvenu à écarter jusqu'ici, mais que nous ne désespérons pas de voir disparaître. Ce serait, à nos yeux, un perfectionnement sérieux, qui rendrait l'appareil Roussel complétement irréprochable à tous les points de vue.

Quoi qu'il en soit, et tel qu'il est aujourd'hui, cet appareil se présente à nous avec des recommandations peu communes, celle de Neudörfer, qui déclare le transfuseur Roussel « le seul instrument autorisé et justifié » ; celle de Heyfelder qui juge qu'avec cet appareil « la transfusion est devenue facile et sans dangers » ; celle de toutes les sommités médicales de Paris : Dumas, Pasteur, Claude-Bernard, De-

(1) Nous croyons devoir ajouter que cette pince-trocart est de l'invention de M. le docteur Roussel.

paul, Pajot, Bouillaud, Larrey, Cloquet, Verneuil, Bouley, Colin, etc., qui estiment le transfuseur Roussel et sa méthode les meilleurs.

Les démonstrations pratiques faites à l'hôpital militaire de Bruxelles ont confirmé une fois de plus la supériorité de cet appareil, qui a répondu pleinement à l'attente générale. Le sang pris du bras d'un infirmier a traversé l'appareil et jailli vivant et sans la moindre trace de caillot. Au nom du service de santé, qu'il représentait, M. l'inspecteur général a adressé à M. le docteur Roussel des félicitations et des remercîments mérités. Grâce à cette invention la transfusion du sang, entourée jusqu'ici de difficultés et de dangers, prendra rapidement rang dans la pratique courante.

Dr Titeca.

PIÈCES OFFICIELLES.

MINISTÈRE
de la
GUERRE.
2e DIRECTION.

Bruxelles, le 7 mai 1876.

Monsieur le Docteur,

Vous avez bien voulu m'adresser votre remarquable ouvrage sur la *Transfusion* en acceptant de venir en Belgique pour y démontrer et enseigner aux autorités médicales de l'armée votre méthode de la transfusion directe du sang de l'homme à l'homme, au moyen de l'appareil dont vous êtes l'inventeur.

Je vous remercie vivement, Monsieur le Docteur, de votre envoi et j'ai l'honneur de vous faire savoir que j'accepte très-volontiers votre proposition.

Veuillez, je vous prie, vous entendre à ce sujet, avec M. le docteur Fromont, inspecteur général du service de santé de l'armée, à Bruxelles. Cet officier général, à qui j'ai fait part du désir que vous m'avez manifesté, s'empressera de vous faciliter les moyens d'atteindre le but que vous avez en vue.

Agréez, etc.

Le Ministre de la Guerre,
(Signé) THIEBAULD.

A Monsieur le docteur J. ROUSSEL *(de Genève), boulevard Saint-Michel, rue Racine,* 2, *Paris.*

INSPECTION GÉNÉRALE
du service de santé
DE L'ARMÉE

Bruxelles, le 20 *mai* 1876.

Monsieur et honoré Confrère,

En réponse à votre lettre du 18 de ce mois, j'ai l'honneur de vous faire savoir que je viens d'écrire à l'un des médecins d'une de nos villes de garnison, pour m'assurer si les trois malades qui m'ont été

signalés, comme pouvant retirer des avantages de la transfusion du sang, peuvent être évacués sur l'hôpital de Bruxelles.

Dès que la réponse de cet officier me sera parvenue, ce qui ne peut tarder, je ferai prendre immédiatement des mesures pour le transport.

Je m'empresserai en même temps de vous faire connaître le jour où vous pourrez vous mettre en route pour notre capitale, où tous les médecins de notre armée seront heureux de vous recevoir et d'assister à vos savantes démonstrations (1).

Je vous prie, etc.

(Signé) Dr Fromont.

INSPECTION GÉNÉRALE
du service de santé
DE L'ARMÉE.
N° 101.

Bruxelles, le 28 *juillet* 1876.

Monsieur le Docteur,

J'ai l'honneur de vous adresser ci-joint copie d'une dépêche de M. le Ministre de la Guerre relative à votre nomination de Chevalier de l'Ordre de Léopold.

Cette distinction si flatteuse dont vous êtes l'objet, et au sujet de laquelle je suis heureux de vous adresser mes sincères félicitations, est un éclatant hommage rendu à un appareil qui est appelé à rendre de signalés services.

Recevez de nouveau, M. le Docteur, mes remercîments pour avoir initié le personnel du service de santé militaire au maniement de votre ingénieux transfuseur dont l'utilité ne saurait échapper à quiconque l'a vu fonctionner.

L'inspecteur général,
(Signé) Dr Fromont.

A Monsieur J. Roussel, *docteur en médecine, hôtel de Suède, Bruxelles.*

(1) Conférences, opérations et démonstrations sur le sang humain : le 12 juin, hôpital militaire ; le 16, hôpital militaire ; le 17, hôpital Saint-Jean ; le 20, hôpital Saint-Pierre ; le 21, à Gand, hôpital militaire et hôpital civil ; le 24, Académie de médecine ; le 26, à Louvain, hôpital de l'Université ; le 22, Exposition d'hygiène et de sauvetage, cabinet du service médical.

Laeken, 17 *juillet* 1876.

LÉOPOLD II, Roi des Belges,
A tous présents et à venir, Salut.

Voulant par un témoignage de notre bienveillance reconnaître le service que le docteur J. Roussel, de Genève, a rendu à l'armée en initiant les médecins militaires à l'emploi d'un appareil de transfusion directe du sang de l'homme à l'homme, appareil dont il est l'inventeur et qui est destiné à rendre de grands services à la chirurgie des champs de bataille,

Sur le rapport de notre Ministre de la Guerre, et sur la proposition de notre Ministre des Affaires Etrangères,

Nous avons arrêté et arrêtons,

M. le docteur J. Roussel est nommé Chevalier de l'Ordre de Léopold.

Donné à Laeken, 17 juillet 1876.
LÉOPOLD.

Par le Roi :
Le Ministre de la Guerre,
(Signé) Thiebauld.
Le Ministre des Affaires Étrangères,
(Signé) Cte d'Aspremont-Lynden.

CONTRIBUTION TO THE MORBID ANATOMY AND PATHOGENESIS OF CHRONIC INTERNAL HYDROCEPHALUS.

By HAROLD J. STILES, M.B., F.R.C.S.Ed.

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Contribution to the Morbid Anatomy and Pathogenesis of Chronic Internal Hydrocephalus.

By Harold J. Stiles, M.B., F.R.C.S.Ed.

In this paper I propose to describe the morbid anatomy of two typical cases of chronic internal hydrocephalus, and to make a few remarks upon the pathogenesis of the condition. It may be well, however, in the first instance, to state shortly the main clinical facts of each case.

Case 1.—T. R., æt. 5 months, was transferred to the surgical side of the out-patient department of the Royal Hospital for Sick Children by my colleague Dr. Cumming.

The infant presented all the clinical features of a well-marked case of chronic hydrocephalus. The cranium was subglobular, with a horizontal circumference of 19 in. The fontanelles and sutures were widely expanded, the superficial veins of the scalp were much dilated, the face small and pointed, the eyes were staring and somewhat divergent, with the sclerotics visible above the cornea, and the body was small and wasted. The mother stated that the child appeared to see and hear quite well, but she complained that he took frequent fits of crying, especially at night. His appetite was rather voracious.

History.—The infant appears to have been healthy at birth, and the labour was normal. The enlargement of the head was first noticed when the child was a fortnight old, and rapidly increased; the crying fits became more severe and frequent. There had been no convulsions, and there was no history of injury to the head.

The parents were living and healthy, but with an alcoholic tendency on the part of the father. Of the five other children, the third died of "croup," the fifth was premature,

and the remaining three are alive and well. Although no definite history of syphilis could be obtained, it was a little doubtful if such a taint could be altogether excluded.

Progress and Treatment. — The child was under treatment from the time it was 8 weeks old until its death at the age of 5 months.

The main facts in the progress of the case may be gathered from the following table:—

Date.	Circumference of head (in inches.)	From ear to ear over vertex (in inches).	Fluid removed (in ounces).
Sep. 27, . .	17¾	10½	
Oct. 7, . .	19	11½	1
,, 11, . .	19¼	11½	
,, 18, . .	19½	11½	2
,, 21, . .	19¾	11½	
,, 25, . .	20¼	11½	
,, 28, . .	20½	12¼	
Nov. 4, . .	21	12¼	2½
,, 11, . .	21½	13	
,, 18, . .	21½	13	
,, 25, . .	20½	12½	3
,, 29, . .	21½	13	
Dec. 5, . .	21¾	13¼	
,, 19, . .	22	13½	3
Jan. 2, . .	22½	14	4½
,, 19, . .	23	14½	5½
Feb. 4 (died), .	23½	15	7

Having regard to the fact that the child was an out-patient, and to the unsatisfactory results which have been obtained by continuous drainage, it was decided to try the effect of repeated tappings, care being taken to use every precaution to avoid the introduction of micro-organisms. After shaving and thoroughly purifying the skin, a small metal trocar and cannula (previously sterilised by boiling) was introduced into the ventricle through the large membranous area of the anterior fontanelle, about 1½ in. from the middle line, on the right and left sides alternately. After withdrawing the fluid, the puncture was securely closed by a large and thick collodion dressing, over which corrosive wool and a domette bandage was applied to keep up a certain amount of pressure. No anæsthetic was used.

It will be seen from the above figures that this treatment did not prevent the progressive enlargement of the head; nevertheless, the mother was quite satisfied that the child was always brighter and screamed less for a few days after tapping. If the necessary precautions be taken to avoid the introduction of micro-organisms into the cranial cavity, the little operation may be said to be devoid of danger, and is, I think, on the whole, the one to be recommended. It is true that such treatment only very exceptionally effects a cure, still, cases have from time to time been reported by John Hern (14) and others in which it has apparently done so, although it is difficult to say in what proportion of these cases the same result might have occurred without tapping. Every care should be taken to prevent leakage from the puncture. This is best done, firstly, by using a small cannula, and, secondly, by applying a large collodion dressing. In spite of these precautions, on one occasion (23rd November) leakage did occur,—as a result, the mother says, of a severe screaming fit when the child was being bathed. Clear cerebro-spinal fluid continued to drain away for five days, and then ceased spontaneously. The result of the leakage was to cause some falling in of the fontanelles, and a reduction of the circumference of the head by 1 in. Two days later, however, the head had regained its former size and tension. The fluid drawn off at the next tapping was quite clear and sterile, thus proving that sepsis had not resulted from the leakage.

In spite of the treatment, the child gradually became more and more emaciated and drowsy, and one morning the mother found him dead in bed. He never had any general convulsions, but during the last few weeks of his existence he had frequent twitchings, more especially of the lower extremities, and some nystagmus.

Case 2 was under the care of Dr. Carmichael in the Children's Hospital, and I am indebted to him for permission to make the following extract from the Hospital record of the case.

E. S., æt. 20 months; admitted 5th February 1892. Complaint: chronic hydrocephalus.

Family history.—Father died of Bright's disease; mother alive and healthy. Five other children, æt. 14, 10, 6, and 5 years respectively, and all healthy, with the exception of the eldest, who suffers from chorea. No mention of syphilis.

The patient was quite well until she was 3 months old, when she took eight fits in one day. The fits began with violent screaming, followed by irregular movements of the right arm and leg, and turning up of the eyeballs. She never had any more fits, but remained dull and unable to hold up her head.

On the child's admission to Hospital, her head was distinctly hydrocephalic, and there was a bed-sore over the right parietal bone the size of a shilling. The expression was vacant and staring, and the body somewhat emaciated. There was no paralysis of the extremities, but the hands were kept clenched and the legs rigidly extended. Some days after admission a second bed-sore formed over the opposite parietal bone. A few days before the child died, vomiting set in, and the temperature became elevated. Death took place on the thirtieth day after admission, and was preceded by a more or less continuous convulsive state which lasted for several hours.

Dr. Bruce, who made the post-mortem, gave a preliminary report of the brain, which, after carefully removing, he placed in Müller's fluid, in order to harden it prior to a subsequent more thorough investigation. On hearing that I was investigating the subject, he very kindly placed the specimen at my disposal.

Before describing it, I may here make the following extract from the post-mortem book: "Horizontal circumference of cranium, 20 in.; anterior fontanelle, 3 in. × 2½ in.; posterior fontanelle, closed. Skull cap less than 1 mm. thick. Dura mater, normal. Convolutions and sulci effaced, and brain converted into a cyst. Considerable increase of arachnoid fluid at the bases, and membranes here œdematous, otherwise normal. Lateral ventricles enormously dilated. A small cyst upon the upper aspect of each choroid plexus. A few fine granules here and there upon the ependyma."

Morbid Anatomy.

As there are few diseases the pathology of which is more obscure, I was anxious, in my own case, to make a thorough examination of the brain. Having obtained permission to do so, I had the head frozen entire, in order that the relation of the parts might be studied as nearly as possible as they existed during life; and to ensure its being frozen throughout, it was kept in the freezing mixture for four days. It was then sawn through into slabs in the vertical coronal plane. Tracings of the more important sections were made at once upon glass, transferred from this to tracing paper, and finally to the block upon which the water-colour drawings were made. The slabs were kept carefully frozen while the drawings were being executed, a little more detail being put into them after the parts had been allowed to thaw for some time, so as to admit of some of the structures being more thoroughly identified. The slabs were then put into spirit, and subsequently more completely dissected.

On account of the profound alterations which the brain had undergone as the result of the disease, considerable difficulty was at first experienced in identifying and obtaining an accurate description of some of the structures, more especially those about the base of the brain. The sectional method of investigation, while it possesses many advantages, has at the same time its disadvantages, one of them being the difficulty which arises in tracing the anatomical continuity of certain of the structures. With the help, however, of Dr. Bruce's specimen, which had been well hardened in Müller's fluid and carefully preserved, I have been able to clear up several points regarding which I was unable to satisfy myself merely from the examination of the frozen slabs.

The pathogenesis of the majority of the cases of chronic hydrocephalus is a subject concerning which there is great difference of opinion, and about which it must, I think, be confessed we know very little. Before we can hope to acquire further knowledge on this matter, we must, in the first place, make ourselves better acquainted with the morbid anatomy of the condition. As the descriptions of the morbid anatomy of

the brain in hydroeephalus are rather fragmentary, and upon many points contradictory, I shall describe the specimens with some anatomieal detail. Sir George Humphry (15) has made the anatomy of hydroeephalic skulls the subject of a most instructive and interesting paper, to whieh I would refer the reader for a full aeeount of the subject. There are several excellent specimens in the museum of the University and of the Royal College of Surgeons; and I am indebted also to my eolleague, Dr. John Thomson, for kindly allowing me to make use of a beautifully prepared skull from a ease whieh had been under his eare. It would serve no useful purpose to refer individually to these various specimens; it will be enough to mention some of their more important features, and to endeavour to show how the morbid ehanges have been brought about.

In the frozen speeimen, the greatest horizontal circumferenee measured 23½ in.; the coronal arc, from ear to ear, 15½ in.; from glabella to inion, 16 in. On aceount of the wide expansion of the upper part of the frontal suture, as well as of the whole of the sagittal suture, the anterior and posterior fontanelles were thrown into one, so that the vertex was almost entirely membranous. This membranous area measured 12½ in. antero-posteriorly by 9 in. transversely; at its narrowest part, between the parietals, it measured 4 in.

Trousseau has very aptly compared the separation of the bones of the vault to the falling back of the petals of an opening flower. We must remember, however, that the enlargement of the head is brought about also by a great inercase in the size of the bones themselves, due, no doubt, to ossifieation occurring *pari passu* with the stretching. If the eranial box were everywhere equally expansile, the pressure exerted by the accumulating fluid within it, being equal in all directions, would result in a uniform enlargement without any change in form. Sinee, however, the skull, from its arehitecture, is not equally expansile in all its diameters, there is produced, along with the enlargement, a change in form which is more or less eharacteristie of the disease. On account of the much greater widening out of the sagittal as compared with the coronal and horizontal system of sutures,

the expansion of the cranium is much greater in the traverse than in the antero-posterior direction. The cephalic index (index of breadth) is about 90 as compared with that of an average skull, in which it is 76. The frontal suture is less extensively opened up, on account of the wedging in of the frontal bone at the base of the skull between the wings of the sphenoid, and in consequence also of its connections with the ethmoid and with the bones of the face. The transverse diameter in the parietal region is thus relatively much greater than that in the frontal region, so that when looked down upon the vertex has a more or less ovoid outline. The increase of the antero-posterior diameter is due mainly to the enlargement of the bones of the vault, more especially of the parietals, assisted by the thrusting forward of the frontals (whereby they come to overhang the face), and to the folding downwards, as it were, of the superior portion of the occipital bone towards the base of the skull, so that the posterior pole of the cranium comes to be formed by the posterior fontanelle. This straightening out of the occipital bone gives rise to the great elongation of the occipital region behind the neck, and no doubt increases the tendency of the head to fall back by throwing the centre of gravity behind its articulation with the spine. There is little or no opening up of the lower part of the coronal suture, which fact, combined with the great expansion of the sagittal suture, is the main factor in producing the pathological brachicephalic condition of the skull. The increase of the vertical diameter, and of the basi-bregmatic height, is due mainly to the enlargement of the parietals, and, to a less extent, to the opening up of the horizontal sutures between the parietals above and the temporals and occipitals below. On looking at the base of the skull, it will be seen to be very distinctly vaulted downwards, so that the foramen magnum and posterior fossa lie in a plane considerably below that of the hard palate. The average index of height in the hydrocephalic skulls to which I have had access is 80, as compared with 71, which is the average of that of a normal British skull. It is the great increase of the height and breadth indices which gives to the typical hydrocephalic cranium its more or less globular shape,

combined with some degree of squareness, due to localised bulging at the frontal and parietal eminences. The bones of the vault are 1 mm., or less, in thickness, and are, of course, devoid of diploe.

The enlargement of the bones is not confined to those which enter into the formation of the vault, for those at the base are also expanded. The expansion of the lesser wings of the sphenoid assist materially in enlarging the anterior fossa. The clinoid processes, the groove for the optic nerve, and the sella turcica, are all well marked. The basi-sphenoid and basi-occiput remain much about their normal size, as also do the petrous temporals, which appear, therefore, relatively to the other bones, to be unduly small. The grooves for the meningeal vessels are very poorly marked; those for the venous sinuses are shallow, but widened. The foramina of exit for the nerves are relatively very small.

The greater wings of the sphenoid and the squamous temporals, forming the middle fossa of the base, are bulged forwards and outwards, so as to almost obliterate the zygomatic and temporal fossæ. The zygomatic arch, in consequence of its connection with the temporal bone, instead of being horizontal, as it normally is, becomes directed obliquely backwards, downwards, and outwards.

Normally, the upper border of the external auditory meatus in the child is only slightly below the level of the infraorbital margin. In the advanced hydrocephalic skull, however, it is on a level with the alveolar border of the lower jaw, and the auricle is correspondingly thrust downwards, and overhung by the cranium. According to Symington ([19]), the membrana tympani is inclined at much the same angle in the child as in the adult, namely, at 45°; in hydrocephalus it may become quite horizontal.

The most striking feature about the facial portion of the skull is, of course, its diminutive size as compared with the cranium; the triangular and pointed appearance is due to the way in which it tapers from the expanded forehead to the chin. The remarkable changes produced upon the orbits are well known, and are largely responsible for the characteristic expression presented by the unfortunate sufferers. The

supra-orbital arch is dragged upwards to such an extent by the expansion and stretching of the frontal bone, that the vertical diameter of the orbital outlet, which in the child is normally less than the traverse, now comes to exceed it. The roof of the orbit—normally arched upwards and directed

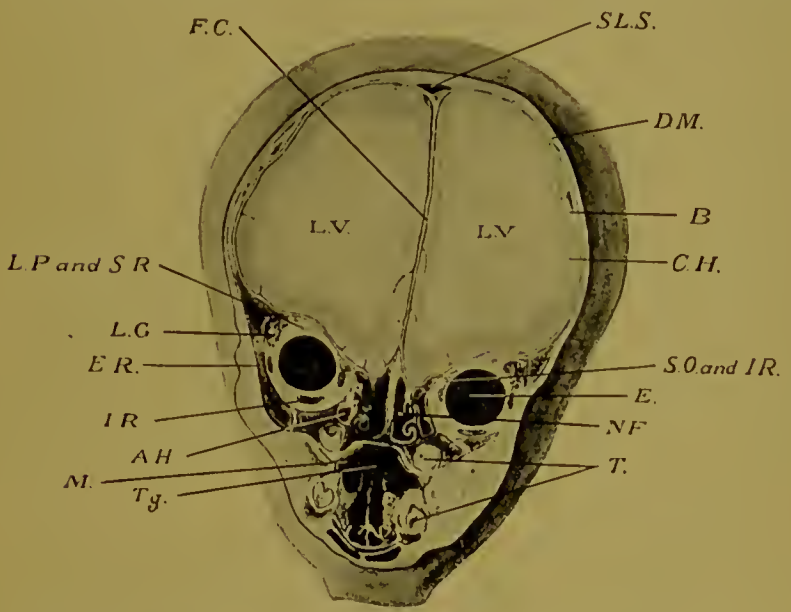

FIG. 1.—Coronal section, viewed from before, passing through frontal region, orbits, nasal cavities, and mouth.

L.V., lateral ventricles; *F.C.*, falx cerebri; *S.L.S.*, superior longitudinal sinus; *D.M.*, dura mater; *B.*, frontal bone; *C.H.*, cerebral hemisphere; *L.P.* and *S.R.*, levator palpebræ and superior rectus; *S.O.* and *I.R.*, superior oblique and inferior rectus; *E.R.*, external rectus; *I.R.*, inferior rectus; *E.*, eyeball; *L.G.*, lachrymal gland; *N.F.*, nasal fossa; *A.H.*, antrum of Highmore; *M.*, mouth; *T.*, teeth.

(Figs. 1 to 5 are from coronal sections of the frozen hydrocephalic head of Case 1.)

only slightly forwards—is pushed downwards and markedly forwards, especially its inner half, which, moreover, is usually more or less membranous. The inner half of the supra-orbital arch may become completely obliterated by the gradual merging of the frontal into the orbital surface of the bone. The peculiar staring expression of the hydrocephalic child, due to the exposure of the white sclerotic above the cornea,

is familiar to all, and is usually attributed simply to the pushing downwards of the eyeball beneath the lower eyelid; it is certainly dependent also upon the elevation of the supra-orbital arch, and to the stretching of the skin of the forehead to such an extent that the upper lid is no longer able to cover so much of the globe. In our own specimen, careful attention was directed to the ocular muscles and their nerves, in order to ascertain whether they had any share in the production of the altered position of the eyeballs. In the frozen slab, represented in Fig. 1, all the orbital muscles were well developed, with the exception of the levatores palpebræ superiores, and the superior recti, which on subsequent dissection were found to be atrophied. The ptosis, and the downward rotation of the eyeball, conditions almost invariably met with in the later stages of the disease, are thus accounted for. The divergence which generally co-exists is due to the greater displacement of the inner and thinner portion of the orbital roof, and possibly also to the comparative freedom from pressure enjoyed by the sixth nerve as compared with the third and fourth nerves.

Although the face looks so diminutive when contrasted with the cranium, it is in reality broader than normal. This is due not only to the expansion of the frontal bone, but also to the broadening of the ethmoid, which increases the distance between the eyeballs. The upper part of the face is farther broadened by the opening out of the angle of the malar bone, due to the bulging of the middle fossa of the skull. With the exception of an increase in the distance between its condyles, the lower jaw undergoes no change, so that the chin gives one the impression of being unduly narrow and pointed. The height of the nasal fossæ does not appear to undergo any alteration. In Fig. 1 the frontal lobes of the brain are seen to be dipping down between the orbits, but this, it will be remembered, is a perfectly normal condition, and does not appear to be exaggerated in our specimen; nor could it well be, on account of the buttresses formed by the septum and outer walls of the nasal fossæ.

As there are one or two points of more or less anatomical interest shown in Fig. 1, I may incidentally refer to them,

although they have no bearing upon the subject under consideration. Symington (9) has shown that when the mouth of an infant is closed, so that the tongue is pressed against the palate and the cavity of the mouth is merely potential, the gums of the superior and inferior dental arches, instead of being in contact, are separated by an interval of 6 mm. This condition is well seen in Fig. 1, the interval between the gums being occupied partly by the edge of the tongue and partly by the folding inwards of the mucous membrane of the cheek, which becomes redundant when the mouth is closed. Notwithstanding the emaciated condition of the child, the fat of the sucking pad is still present.

Fig. 2, *L.G.*, *Sm.G.*, shows the intimate relation to the submaxillary salivary gland, of one of the lymph glands, which is here enlarged. This is a point worthy of note in regard to the pathology of angina Ludovici, an affection which, in the writer's experience, is by no means unknown in children, and which is probably nothing more or less than an acute infective adenitis, along with extensive brawny periadenitis, originating, not in the salivary gland, but in the lymphatic gland.

A small proportion of hydrocephalic subjects reach adult life. The membranous areas then become completely ossified, partly by expansion of the ossifying process from the edges of the surrounding bones, but mainly by the formation of independent centres of ossification, resulting in the production of Wormian bones, which may be very numerous. In well-marked cases of hydrocephalus, the skull retains, to a considerable extent, the configuration above described as characteristic of the disease. The bones, however, never attain their normal thickness, and contain little or no diploe.

In the Anatomical Museum of the University, one of the skulls labelled "chronic hydrocephalus" (specimen N.A. i. 12) is of interest, inasmuch as, although possessing an abnormally large cranium, it is, nevertheless, wanting in almost all the features above described as characteristic of the disease. That it is the skull of an adult is evident from the well-marked muscular eminences, and from the prominences of the frontal sinuses. The horizontal circum-

ference of the cranium measures 24¾ in., that of an average cranium measuring 20 in. Its greatest length is 8½ in.; the greatest parietal breadth is 7 in.; and the basi-bregmatic height is 5¾ in. Its index of breadth is 85, thus resembling a typical hydrocephalic skull in being brachi-cephalic. The index of height is normal, namely 71. There is no bulging of the forehead, or of the parietal eminences. The greatest parietal breadth is only ½ in. more than the greatest frontal breadth. The posterior pole is formed by the occipital bone, and there is no vaulting of the base. The frontal suture is still present, while the greater part of the sagittal is obliterated. There are no Wormian bones. The supra-orbital arch and the orbital diameters are normal. There is no bulging of the middle fossæ, and the zygomatic arch is horizontal. Moreover, the face is not disproportionately small. There is, however, one point which should be mentioned in favour of hydrocephalus, namely, that the eminences and depressions upon the inner surfaces of the cranium are almost obliterated, and the calvarium is distinctly thinner than normal. The right half of the cerebellar fossa is considerably smaller than the left half, so that there is a decided want of symmetry in the occipital region. Sir George Humphry ([15]), in the paper already referred to, gives notes of five adult hydrocephalic skulls; and this one evidently belongs to the same category. Remarking upon his specimens, Humphry writes as follows:—"In these five adult crania the disproportion between the brain-case and the facial part is not so marked as in the infantile specimens, which is attributable in part to the predominant growth of the facial part in early extra-uterine life, and partly to the hydrocephalic disease being less in amount, and allowing the adult period to be reached, and the adult relation between the facial and the cranial parts to be, to a certain extent, attained; and it is to be remarked that the excessive growth of the cranial part of the skull is associated with, directly or indirectly productive of, some excessive growth of the facial parts. This also probably accounts for the fact that in most of the adult specimens the orbits have their natural shape, and do not present the obliquity in their roofs caused by the

pressure of the intra-ventricular fluid, which is so marked in the infantile specimens."

I shall now pass to the description of the brain and its membranes in the two cases.

In the post-mortem record of Dr. Carmichael's case, it is stated that the dura and its blood sinuses were normal, and that there were no adhesions between it and the arachnoid. There was a considerable increase of arachnoid fluid at the base, and the arachno-pia was œdematous.

In my own specimen, the dura, apart from being thin, was normal. The lower border of the falx was highly arched, and had dragged upwards the tentorium, so that on coronal section its two halves each formed a very obtuse angle with the falx (Fig. 5). The space thus left between the elevated tentorium and the upper surface of the cerebellum was occupied by a hernia-like diverticulum from the lateral ventricles (Fig. 4, *), about which more will be said later on. The cranial blood sinuses, as a result of the stretching of the dura and of the pressure exerted upon them from without, presented a triangular and, in some cases, a chink-like outline, the latter being the condition of the straight sinus (Fig. 5, *S.S.*), which was otherwise normal. There were no adhesions between the dura and arachnoid. The arachno-pia was examined for signs of meningitis, but none could be detected. The sub-arachnoid space in the inter-peduncular region contained a sheet of ice of some thickness, separated from that in the third ventricle by its thin, membrane-like floor. In order that the cisterna cerebello-medullaris and the parts about the roof of the fourth ventricle might be examined, the block from which Fig. 4 was taken was carefully dissected by removing the neural arches of the upper cervical vertebræ, the spinal dura, and a portion of the middle lobe of the cerebellum. It was found that the sub-arachnoid space was here practically obliterated by the jamming of the cerebellum down upon the posterior surface of the medulla, and that a somewhat condensed and adherent membrane intervened between the two. The foramen of Magendie was evidently closed. Since Hilton (7) drew attention to the closure of this foramen in basal meningitis, it has been frequently

referred to by subsequent writers, and put forward as an argument in support of the hypothesis that the majority of chronic as well as of acute cases of hydrocephalus are the result of a chronic basal lepto-meningitis, with or without a co-existent ependymitis. That such may be the pathogenesis

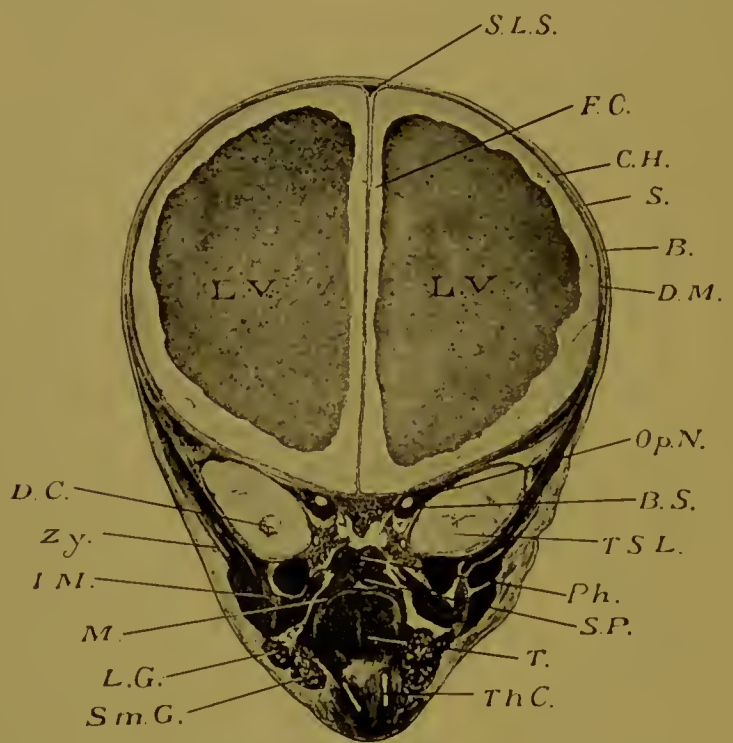

FIG. 2.—Coronal section, viewed from behind, passing through frontal and tips of temporo-sphenoidal lobes, sphenoid, soft palate, and root of tongue.

Op.N., optic nerve; *B.S.*, basi-sphenoid; *T.S.L.*, tip of temporo-sphenoidal lobe; *D.C.*, tip of descending cornu of lateral ventriele; *Zy.*, zygoma; *Ph.*, pharynx; *S.P.*, soft palate; *I.M.*, inferior maxilla; *L.G.*, lymphatic gland; *Sm.G.*, submaxillary gland; *Th.C.*, thyroid cartilage. Remaining lettering as in Fig. 1.

of some of the acquired forms of hydrocephalus, there can be no doubt, but that it is also the cause of the ordinary chronic form,—that is to say, of cases similar to the ones now under consideration,—I do not think there is sufficient evidence to show. On the contrary, it appears to the writer that to regard this obliteration of the sub-arachnoid space as responsible for the hydrocephalus, is to confuse cause and effect. In

the absence of any further evidence of meningitis, it seems much more reasonable to look upon the obliteration of the subarachnoid space between the cerebellum and medulla and the closure of the foramen of Magendie as secondary to the pressure exerted by the distended lateral ventricles. Were the hydrocephalus due to the closure of the foramen of Magendie, the fourth ventricle ought to be dilated, as well as the lateral and third ventricles. Such dilatation, however, is exceedingly rare.

The most striking condition presented by the brain in the two cases was, of course, their cystic condition, due to the accumulation of fluid within the lateral and third ventricles. Over the vertex the cerebral substance was reduced to a thickness of from 2 to 5 mm., and the convolutions and sulci were completely effaced. What remained consisted almost entirely of grey matter. Owing to the much greater resistance offered by the base of the skull, the brain substance occupying this region was comparatively little altered, the convolutions and sulci being quite distinct. The grey matter appeared to be of almost normal thickness, but the white matter formed a comparatively thin layer (Figs. 3 and 4).

The cystic condition was confined to the lateral and third ventricles. In Figs. 3 and 4 the former are seen to have been converted into one huge sac, deeply indented by the fornix in the middle line above, and communicating freely with the third ventricle below. The intraventricular basal ganglia are usually described as broadened out and flattened. Such was their condition in the frozen brain, but no doubt the freezing had a large share in producing it. In Dr. Bruce's specimen (Plate XX.), the corpora striata and optic thalami, although broadened, appeared much more prominent than normal, in consequence of the way in which they had been thrown into relief, as it were, by the relatively much greater thinning of the parts of the brain adjacent to them. The anterior and posterior cornua were enormously dilated, the former occupying practically the whole of the anterior fossæ, and the latter stretching over the tentorium cerebelli to the posterior pole of the skull. The cornua of opposite sides were separated from each other by the falx, and the cerebral

mantle covering its lateral aspects. The descending cornua, owing to the greater thickness of the mantle of the tempero-sphenoidal lobes, were much less capacious. In my own specimen (Fig. 3) they measured $\frac{3}{4}$ in. in diameter; in Dr.

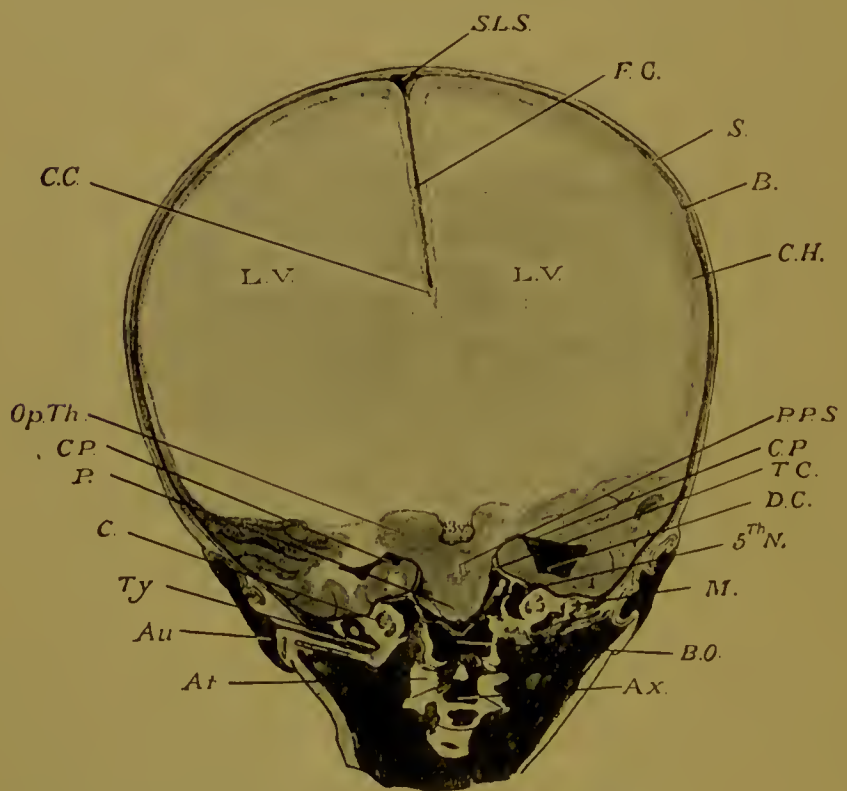

FIG. 3.—Coronal section, seen from before, passing through third and lateral ventricles, pores, basi-occiput, upper cervical vertebræ, and auditory apparatus.

C.C., corpus callosum; 3 *v.*, third ventricle; *Op.Th.*, optic thalamus; *P.P.S.*, posterior perforated spot; *P.*, pons; *D.C.*, descending cornu of lateral ventricle; *C.P.*, choroid plexus; *T.C.*, tentorium cerebelli; *5th N.*, fifth nerve; *C.*, cochlea; *Ty.*, tympanum; *M.*, malleus; *Au.*, auricle; *B.O.*, basi-occiput; *Ax.*, axis. Remaining lettering as in Fig. 2.

Bruce's, they appeared to have been more dilated, forming two wide, funnel-shaped excavations behind and beneath the posterior extremities of the caudate nuclei and optic thalami.

In both specimens the ependyma was very slightly thickened, but otherwise normal.

It may lead to a clearer conception of the morbid changes

which have been brought about by the disease, if it be pointed out, at the outset, that the cerebral hemispheres become converted into one huge, hourglass-shaped cyst, the shape of which is dependent upon the dura and its processes, to the surface of which it becomes moulded.

As the lateral ventricles become dilated, the corpus callosum is gradually raised up from the fornix. The subarachnoid space at the bottom of the great longitudinal fissure soon becomes obliterated by the upper surface of the corpus callosum coming in contact with the lower edge of the falx cerebri. Ultimately the corpus callosum can no longer be detected as an independent structure, although theoretically, of course, it is represented by the very thin strand of white matter running along the lower edge of the falx (Fig. 3, *C.C.*). The septum lucidum becomes stretched, and usually disappears altogether, as has happened in my own case. In Dr. Bruce's specimen (Plate XX., *S.L.*) it is represented merely by three slender cords — one on the right side and two on the left—extending from the corresponding half of the anterior part of the fornix forwards and upwards, to be attached to, and lost upon, the thin layer of brain substance reflected over the lower edge of the anterior part of the falx, and representing the remains of the corpus callosum. In length these cords measured 4 cm., and were of the thickness of medium-sized surgical catgut. In all probability they are the remains of the obliterated veins of the septum lucidum, and are the only structures left to represent that organ. The highly arched condition of the falx, and the elevation and disappearance, practically, both of the corpus callosum and of the septum lucidum, throw the lateral ventricles into free communication with each other through a large, oval opening occupying the mesial plane. This opening is bounded above by the lower edge of the falx (covered by the remains of the corpus callosum); below, by the anterior pillars of the fornix, the anterior part of the third ventricle, and the velum and interpositum; in front, by the anterior recurved extremity of the lower edge of the falx; posteriorly, by its junction with the tentorium cerebelli. In Dr. Bruce's specimen the

aperture measured 4 cm. from before, backwards; in my own case it measured 6 cm. from above, downwards (Figs. 3 and 4).

The statements regarding the fate of the fornix vary

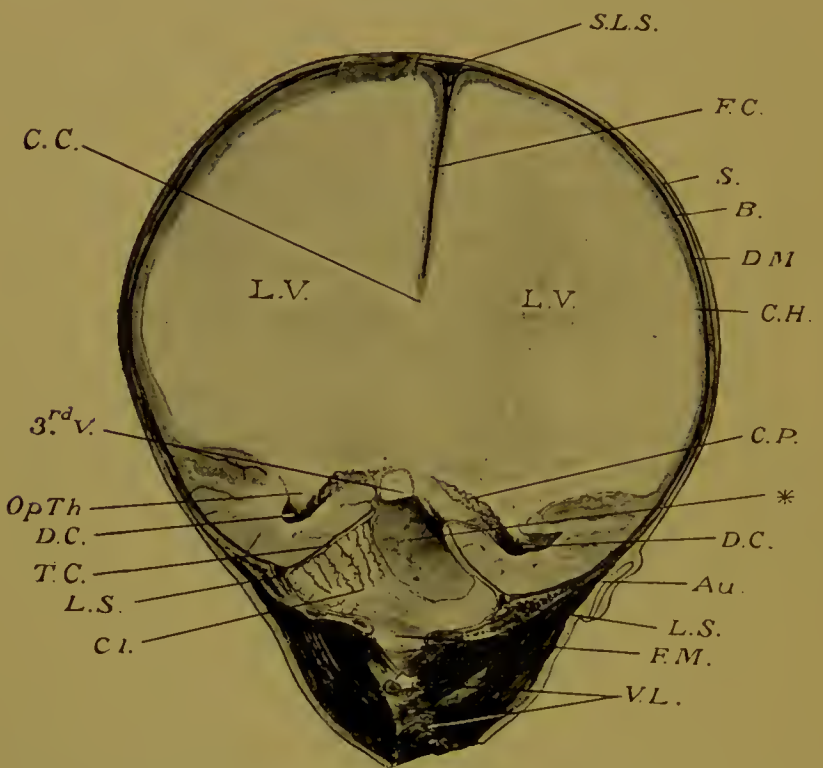

FIG. 4.—Coronal section at the level of the great transverse fissure, viewed from behind, and passing through posterior part of third ventricle, commencement of descending cornua of the lateral ventricles, cerebellum, posterior part of foramen magnum, and laminæ of upper cervical vertebræ.

C.P., choroid plexus; *3rd V.*, posterior part of third ventricle; *Op.Th.*, posterior extremity of optic thalamus; *D.C.*, descending cornu of lateral ventricle; *L.S.*, lateral sinus; *Cl.*, cerebellum; *F.M.*, foramen magnum; *V.L.*, vertebral laminæ; *, sub-tentorial diverticulum of lateral ventricles. Remaining lettering as in Fig. 3.

considerably. In a specimen described by John Thomson ([12]) it was said to be absent. Dickinson ([2]) refers to it as being diffluent. West ([13]), on the other hand, states that "in seven post-mortem examinations of children affected with chronic internal hydrocephalus, he found the fornix present in all; in three, it and the septum lucidum

were thickened and tough; in two, they were torn and softened (the result of a subsequent acute inflammation); in one the septum lucidum was absent; and in one, both it and a large portion of the fornix were wanting." In the text-books on nervous diseases no mention whatever is made of the fornix. The question as to the presence or absence of this structure is of some importance, as helping to determine how far the hydrocephalus is to be regarded as an arrest of development, and if so, at what stage the arrest begins.

In Dr. Bruce's specimen there was no doubt about the fornix having been developed. In Plate XX. (*F.*), the anterior pillars are seen as two rounded cords, 2 mm. in thickness, arching upwards above the anterior part of the third ventricle; traced forwards, they are seen to bend downwards and converge at the anterior part of the third ventricle, where, after forming the corpora albicantia (*C.A.*), they diverge from one another, and finally become lost upon the inner surface of the optic thalami. Tapering and converging as they arch backwards, they ultimately join upon the upper surface of the velum interpositum, a little behind the meeting-point of the anterior extremities of the choroid plexuses. After the anterior pillars have joined, the fornix can no longer be traced as an independent structure, but the body appears to be represented by a thin layer of white matter covering the remains of the velum interpositum, which stretches over the posterior part of the third ventricle from one optic thalamus to the other. Faint indications of the posterior pillars are seen in the shape of two slight elevations winding over the posterior extremities (pulvinar) of the optic thalami, and thence onwards to be lost upon the wall of the descending cornua of the lateral ventricles. In the frozen slabs it was at first difficult to speak with certainty as to the fornix. In the notes taken at the time of dissection, I find it stated that no trace either of the body or of the posterior pillars could be discovered; but on dissecting the posterior surface of the slab, which displayed a section through the anterior part of the third ventricle, two white cords were seen curving downwards in front of the third

ventriele towards its floor, where they diverged from each other and then became lost upon the optic thalami. There ean be little doubt, I think, that from their position and eonnections these struetures represent the anterior pillars of the fornix.

In this slab, and the one immediately behind it (Fig. 3),

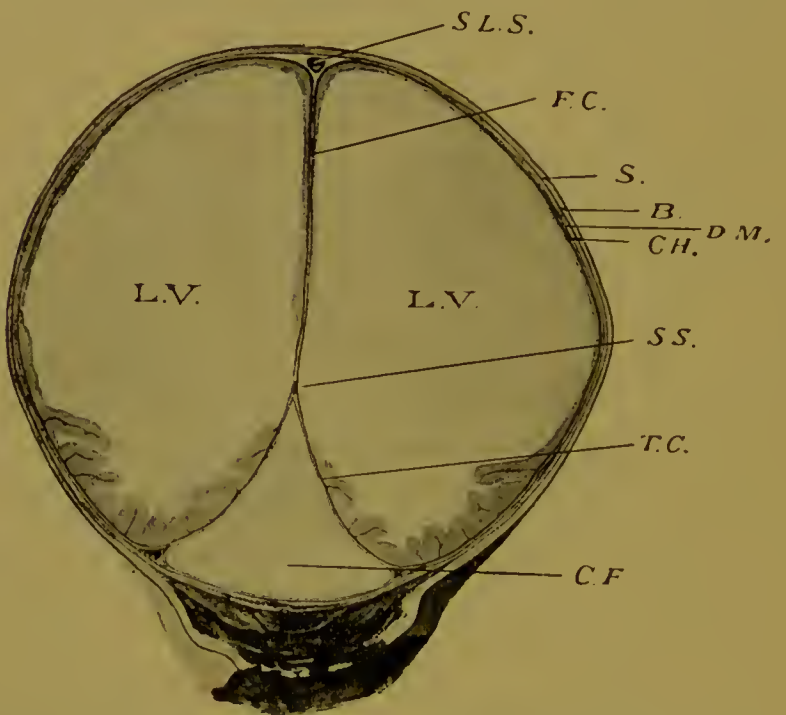

FIG. 5.—Coronal section, viewed from behind, passing through occipital lobes, tentorium cerebelli, cerebellar fossa, and occipital bone behind foramen magnum.

L.V., posterior cornua of lateral ventricles; *S.S.*, straight sinus; *T.C.*, tentorium cerebelli; *C.F.*, cerebellar fossa. Remaining lettering as in previous figures.

the third ventriele presented itself as a trough-like depression bounded by the optie thalami on either side, and opening above directly into the fused lateral ventrieles. The anterior or infundibular portion was deepened to form a sac-like divertienlum, beneath which was the optic commissure, somewhat flattened.

In neither of the two specimens did the ehoroid plexuses of the lateral ventricles present any morbid eondition of importanee. In Dr. Bruce's speeimen eaeh contained a small

cyst about half the size of a pea. Such cysts are quite commonly met with in conditions apart altogether from hydrocephalus, and are, therefore, of no importance. In Fig. 4, which represents a section opposite the great transverse fissure, the choroid plexuses are seen stretching almost transversely across the optic thalami, round the posterior extremities of which they wind, to disappear into the descending cornua of the ventricles. Between the plexuses is the velum interpositum, which, owing to the widening out of the foramen of Monro, stretches forwards only for a very short distance, and therefore roofs over only the posterior part of the third ventricle. Upon its under surface the two shortened choroid plexuses of the third ventricle could be made out. In both specimens the upper surface of the velum is covered with ependyma, continuous with that lining the lateral ventricles. In the Müller specimen, some fibres of the fornix appeared to intervene between the ependyma and the velum; but it was impossible to say whether this was the case also in the frozen brain.

The aperture seen just below the velum (Fig. 4, *3rd V.*) is a section of a diverticulum which extended backwards from the third ventricle. It contained a small block of ice which, when traced through to the anterior surface of the slab, was found to be directly continuous with the ice occupying the posterior part of the third ventricle. From its position and relations, this diverticulum no doubt represents the hollow stalk of the pineal gland (and probably also the gland itself, since this structure could not be discovered), which had been dilated into a small sac. It projected into, and was surrounded by, a second and much larger sac (Fig. 4, *), which has already been referred to as intervening between the under surface of the tentorium and the upper surface of the cerebellum. On removing the block of ice from this sac, it was found to be lined by ependyma, directly continuous, through the opening in the tentorium, with that which we have just seen covering the upper surface of the velum interpositum, and through it, again, with the ependyma of the lateral ventricles. On tracing the ependyma of the sac backwards, it was reflected upwards on to the under surface of the

tentorium, and thence over its edge and round the margin of the limbic lobe (gyrus fornicatus) of each hemisphere into the lateral ventricles again. Externally, the ependyma was covered with pia mater, the two being intimately blended, and forming together the wall of the sac.

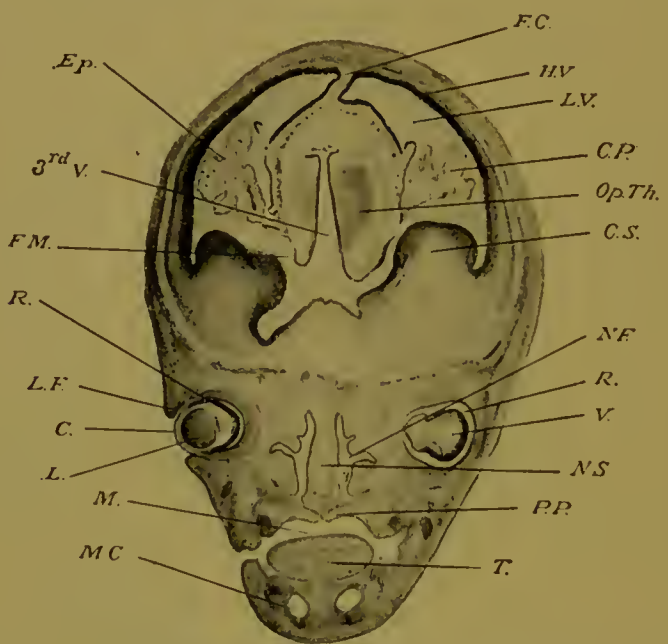

FIG. 6.—From a photograph of a microscopic coronal section of the head of a seventh-week human embryo, illustrating the development of the fore-brain.

F. C., falx cerebri; *H. V.*, hemisphere vesicle; *L. V.*, lateral ventricle; *C. P.* choroid plexus; *Ep.*, its epithelial covering, continuous with and derived from the inner wall of the hemisphere vesicle; *3rd V.*, third ventricle; *Op. Th.*, anterior end of optic thalamus; *C.S.*, corpus striatum; *F.M.*, foramen of Monro; *R.*, retina; *V.*, vitreous; *L.*, lens; *C.*, cornea; *L.F.*, lid fold; *N.F.*, nasal fossa and rudimentary turbinals; *N.S.*, nasal septum; *P.P.*, palatal process, about to fuse with its fellow and with the lower edge of the nasal septum; *M.*, mouth; *T.*, tongue; *M.C.*, Meckel's cartilage.

In order to understand the real nature and mode of formation of this sac, we must refer for a moment to the normal brain, and examine the relation of parts seen in a vertical coronal section at the level of the posterior part of the corpus callosum. Below, and upon either side of this structure, are the two lateral ventricles cut across just in front of their bifurcation into the posterior and descend-

ing cornua. The floor is here formed by the posterior part of the upper surface of the optic thalamus, resting upon which is the choroid plexus and the posterior part of the body of the fornix, just where it gives off the descending pillar. The two ventricles are here partitioned off by the adhesion of the apposed surfaces of the corpus callosum and fornix. This union is by no means a firm one even in the normal brain; indeed, a small compressed cavity (Verga's ventricle) sometimes exists between the two. Beneath the posterior part of the corpus callosum and the commencement of the posterior pillars of the fornix is the middle part of the great transverse fissure occupied by the fold of pia mater, which is projected forwards over the corpora quadrigemina, and thence onwards to form the roof of the third ventricle.

Now, as the head enlarges, and the lateral ventricles become distended, the corpus callosum and septum lucidum become stretched, and ultimately more or less absorbed, so that the bodies of the lateral ventricles are thrown into free communication with one another above the anterior pillars of the fornix. The next thing that happens is that the corpus callosum becomes gradually stripped from before backwards from off the fornix, so that Verga's ventricle becomes a part of the fused bodies of the lateral ventricles. Meanwhile the body of the fornix, becoming thinner and thinner, can no longer be recognised as an independent structure; and the fused lateral ventricles, which extend farther and farther backwards as they dilate, come at length to overlap the upper surface of the velum interpositum as far back as where the lower edge of the falx joins the anterior edge of the tentorium. In our own specimen this diverticulum of the lateral ventricles has, in consequence of the dragging upwards of the tentorium by the falx, extended still farther backwards, and formed a sac-like extension between it and the upper surfaces of the corpora quadrigemina and cerebellum. The only references I have been able to find to a condition in any way approaching this are by Dickinson (2) and by Gowers (4). The former refers to a case in which "there was a sort of extra ventricle formed by the separation of the tentorium from the upper surface of the cerebellum, this cavity being in free com-

munication with each lateral ventriele by a large round opening at the outer part of the transverse fissure on either side." There can, I think, be little doubt that we have here again to do with a diverticulum of thc lateral ventricle, originating in the way above described. Gowers, in referring to the raising of the tentorium by the stretehing of the falx eerebri, mentions that this increases the size of the subtentorial spaee which "is not completely filled by the eerebellum, the interval being oceupied by liquid and sometimes by loose eonneetive tissue." In our own specimen, the effeet of this hernial condition was to drive the cerebellum downwards and forwards so as to flatten and eompress it against the floor of the cerebellar fossa (Fig. 4, *Cl.*). The greater part of the medulla, the eerebellar tonsils, and part of the inferior vermiform proeess, were all displaeed through the foramen magnum into the spinal eanal. There was no dilatation of the fourth ventricle. The spinal eord appeared to be normal, and there was no dilatation of the central canal. In Dr. Bruee's speeimen there was no subtentorial diverticulum of the lateral ventricles, but their fused bodies extended over the velum interpositum as far as the anterior edge of the tentorium.

The form and relations of the parts about the third ventricle are well seen in Plate XX. The third ventricle, related as it is to the unyielding base of the skull, and supported by the basal ganglia, undergoes, apart from dilatation, comparatively speaking, but little modifieation. Anteroposteriorly, from the lamina terminalis to the posterior eommissure, it measured 3 cm.; at its widest part, opposite the anterior extremities of the optic thalami and the foramen of Monro, it measured 11 mm. Its deepest part, measuring 17 mm., is situated anteriorly, and eorresponds to the infundibular region. Here it forms a well-like extension, which, when viewed from the exterior, appears as a somewhat thin-walled, bladder-like protrusion, upon which the optic commissure rests. This anterior or infundibular region of the third ventricle opens above direetly into the confluent bodies of the lateral ventricles through an oval opening, measuring 18 × 8 mm., situated between the anterior pillars of the

fornix. The foramen of Monro, in this specimen, is converted into a triangular aperture (Plate XX., *F.M.*) measuring 11 × 4 mm.; it is bounded above and in front by the anterior pillars of the fornix, below and behind by the anterior part of the optic thalamis. Through the narrow posterior extremity of the opening, the anterior end of the choroid plexuses of the lateral ventricles wind round on to the under surface of the roof of the third ventricle. By many authors, the foramen of Monro is described as being very much larger than above stated. In the case described by Dickinson (2), in which the circumference of the head measured 30 in., the foramen of Monro is said to have been stretched to a diameter of 3½ in. "It was not quite circular in shape, and was crossed by filaments of pia mater. From the edges of this opening two thin laminæ of cerebral tissue passed vertically, and formed the inner wall of each lateral ventricle." It appears more than probable that the aperture here referred to is not, strictly speaking, the foramen of Monro, but the large oval aperture which has been already described as existing between the lower edge of the falx and the third ventricle. The "filaments of pia mater" no doubt represent the remains of the septum lucidum, and correspond to the delicate cords described in Dr. Bruce's specimen as stretching across the opening from the anterior pillars of the fornix to the lower edge of the falx. In John Thomson's (12) specimen the foramen of Monro is described as being enormously dilated, and measuring 1¼ in. in diameter. In his specimen, however, the fornix could not be made out, so that here again it is probable the foramen of Monro and the space produced by the elevation of the corpus callosum have been thrown into one. A similar condition appears to have been brought about in my own specimen.

To return to Dr. Bruce's specimen (Plate XX.). On looking into the third ventricle from the front, a rounded aperture, of the diameter of a crow quill, led into a cavity which extended backwards for a distance of 1½ cm. At first sight this appeared to be either a diverticulum of the third ventricle occupying the pineal region, or the dilated aque-

duct of Sylvius. When further investigated, by cutting into it from above, it was found that neither surmise was correct; we had to do simply with the posterior part of the third ventricle, namely, the part which slopes upwards and backwards towards the aqueduct, under cover of the remains of the body of the fornix, which, as we have seen, was spread out upon the upper surface of the velum interpositum. The rounded opening leading into this part of the ventricle was bounded, above, by the fork-like divergence of the anterior pillars of the fornix; below, by what turned out to be the middle commissure (Plate XX., *M.C.*).

In all the descriptions I have been able to refer to, the middle commissure is stated to be absent. In the specimen before us it was present in the form of a thick cord-like structure measuring 4 mm. in length and 3 mm. in thickness, and uniting the inner surfaces of the optic thalami about midway between their anterior and posterior extremities. The posterior commissure (Plate XX., *P.C.*), although a much more delicate structure, could be satisfactorily identified at some little distance above and behind the entrance to the aqueduct. The pineal gland could not be discovered. As in the frozen specimen, owing to the widening of the foramen of Monro, the choroid plexuses of the lateral ventricles stretched almost horizontally across the optic thalami from one descending cornu to the other.

The mid-brain did not present any noteworthy alterations in either of the two cases. In Dr. Bruce's specimen it appeared to be perfectly normal; there was not even any flattening of the quadrigeminal bodies. The aqueduct of Sylvius was certainly not dilated; indeed, it was a question as to whether its anterior end was even patent, but this point can only be settled by a microscopic examination, which I have had no opportunity of making. In the frozen specimen, the quadrigeminal bodies were flattened almost beyond recognition by the block of ice which occupied the posterior diverticulum of the lateral ventricles. The aqueduct appeared to have been obliterated by pressure. In the Müller specimen, without careful dissection, the posterior part of the third ventricle (Plate XX., *3rd Vb.*) might so easily be mistaken

for a dilated aqueduct, that it is more than probable this error has actually been committed in the reports of post-mortem examinations of hydrocephalic brains. The funnel-shaped dilatation, which is sometimes referred to as occurring at the anterior end of the aqueduct, may, in some cases, have been nothing more or less than the posterior part of the third ventricle.

Pathogenesis.

"This subject," says Hamilton ([5]), "is so complicated that it would be injudicious to say much about it; there are so many possibilities, and so few facts to support them, that it would require much definite experimental evidence to arrive at anything like a satisfactory conclusion." While fully appreciating both the difficulty and the obscurity of the subject, I think that, after a careful inquiry into the morbid anatomy of the disease, a few remarks on the pathogenesis of the condition may be permitted, even at the risk of not being able to make any important addition towards the solution of the problem. I shall confine my remarks to those cases in which no obvious lesion exists to account for the hydrocephalus.

Several more or less plausible explanations of the condition have been put forward, but none of them can be said to have advanced much beyond the stage of hypothesis. That in many cases the affection is already so far advanced at birth as to give rise to difficulty in the passage of the head along the maternal passages, is of course well known. It should be remembered also, that the ventricles may be markedly dilated without giving rise to any enlargement of the head, and that this may occur in infants as well as in adults. Such cases have been described, more especially by Chiari ([1]). It is only fair to suppose that in those cases in which the head begins to enlarge within a few weeks or months after birth, and in which no obvious cause or lesion is discoverable post-mortem, that the condition is here also probably congenital.

Admitting, then, the congenital origin of the two cases I have described, we have next to consider their causation. We

have already seen that nothing was discovered pointing to an inflammatory origin; the condensation of the arachno-pia between the cerebellum and the medulla is to be regarded as the result, rather than the cause, of the hydrocephalus. According to Dickinson ([2]), Francis Miles ([8]), and others, such non-inflammatory hydrocephalic conditions result from the extra intra-cranial pressure caused by whooping cough, chronic bronchitis, crying, etc., acting upon a cranial box, the resistance of which has been diminished by mal-nutrition, more especially that associated with rickets. Such a close etiological relationship between rickets and hydrocephalus cannot be established, and most writers on the subject refuse to accept this explanation, and, I think, with much reason upon their side.

The influence of syphilis, while denied by some, is regarded as an important cause of hydrocephalus by Heller ([6]), Titomanlio ([11]), and others. That a definite history of syphilis can be got in a number of cases is certain, but it is equally certain that in many cases no such taint exists. That the disease sometimes affects more than one member of a family points just as much to a congenital arrest of development as it does to syphilis. It is only after sufficiently reliable and numerous statistics have been obtained, that we can rightly estimate the importance of specific disease in the causation of hydrocephalus. Even admitting its influence, it is difficult to say whether it acts by interfering with the development and resistance of the cranial wall, or by giving rise to chronic basal meningitis. The beneficial effects which have been observed to follow the administration of mercury in a few cases, may be explained on the assumption of their specific origin.

Alcoholism in the parents can hardly be regarded as of primary importance in the etiology.

To content ourselves by saying that the condition is an "essential dropsy," is nothing more or less than to confess our ignorance: it brings us no nearer the truth, and leaves us with the cause of the dropsy still to be accounted for. When the disease has advanced to a certain degree, a dropsical element is no doubt superadded, due to the intra-cranial

pressure, interfering with the venous return to a greater extent than with the inflow through the arteries.

We are thus brought to consider how far the hydrocephalus is to be regarded as dependent upon an arrest in the development of the brain. It appears to the writer that the balance of evidence is in favour of this mode of origin. In the first place, we have the fact that in many cases the hydrocephalus is already existent at birth, and it is difficult to account for this upon a purely inflammatory hypothesis. Again, in many cases spina bifida co-exists along with the hydrocephalus. This occurred in 9 out of 21 cases described by Chiari (1); in one there was extroversion of the bladder and a congenital abnormality of the liver. According to Recklinghausen, the primary error in spina bifida consists in the arrest of development of the mesoblastic elements, which go to embrace the cord and to close in the posterior median line of the body. Thoma(10), on the other hand, regards this as secondary, and dependent on late closure or persistent patency of the medullary groove. In the rare congenital condition known as salpingomyelus, where the whole spinal canal is dilated, we have a condition analogous to what occurs in congenital hydrocephalus, along with which, indeed, it sometimes, though rarely, co-exists. It has been shown that hydrocephalus may occur very early in fœtal life, and, according to Förster (3) and others, a certain proportion of cases of cranioschisis owe their origin to rupture of an embryonic hydrocephalic brain.

Chiari (1), in an elaborate monograph, has pointed out that in congenital hydrocephalus important alterations are not infrequently found in the cerebellum and medulla. In 22 per cent. the tonsils and inferior vermiform processes of the cerebellum accompany the medulla into the spinal canal in the form of a plug-like extension. In one instance this process extended down to the origin of the fourth cranial nerve. Chiari regards this downward extension of the cerebellum not as a passive process, but as the result of the growth of the tonsils into the only space available. The remainder of the cerebellum is flattened, but otherwise normal. The above changes show that the hydrocephalus occurs before the cerebellum

has developed, thus proving its congenital origin. In 11 per cent. of the cases the fourth ventricle extended into the spinal canal in the form of a pouch, containing within it an extension of the vermiform process. Chiari explains this condition by supposing that the hydrocephalus had begun at a much earlier date, that is to say, at a time when the dorsal wall of the posterior cerebral vesicle is less completely developed, the result being that the subsequent hydrocephalus tells specially upon the fourth ventricle. In one of the cases recorded by Chiari, the child was operated upon for a supposed cervical spina bifida. This, on post-mortem examination, turned out to be the dilated fourth ventricle, which, along with almost the whole of the imperfectly developed cerebellum, formed a cystic swelling projecting from a cleft in the cervical region, involving the three upper cervical vertebræ. The lateral and third ventricles, and the aqueduct, were all widely dilated; and it is interesting to note, also, that the tentorium cerebelli was represented merely by two narrow processes attached to the petrous bone. This case, therefore, well illustrates the close relationship which exists between hydrocephalus and spina bifida.

By reference to other developmental conditions of the brain, further evidence might be adduced in favour of congenital hydrocephalus being essentially an arrest of development of the brain: for instance, when the corpus callosum is absent, the lateral and third ventricles are markedly dilated.

In order that the nature of the developmental arrest which gives rise to hydrocephalus may be better understood, I may refer shortly to Fig. 6, which represents a microphotograph of a preparation selected from a complete series of vertical coronal sections which I have made through the head of a seventh-week human embryo which was kindly sent me by Dr. Arthur Stiles of Spalding. It shows remarkably well the condition of the brain at this period of its development. The cerebral hemispheres are represented by two hollow vesicles separated by a process of vascular mesoblastic tissue in which the falx cerebri is developed. The wall of each vesicle, except at its base, is thin, so that

the cavity, representing the lateral ventricle, is relatively very large. The inner wall of the hemisphere is reduced, at its lower part, to a single layer of cubical cells. It is in this situation (represented at a still earlier stage by a fold in the wall, called the choroidal fold) that the mesoblast which covers the hemisphere grows out into the ventricle in the form of a pedunculated and somewhat branching mass of delicate vascular tissue—the choroidal plexus. This structure, strictly speaking, is outside the cavity of the ventricle, being covered by the single layer of epithelium, which, morphologically speaking, represents the invaginated wall of the hemisphere.

Between, and overlapped by the primitive hemispheres, is the basal portion or stalk of the original anterior primary cerebral vesicle, the cavity of which has been reduced to a deep slit-like space representing the anterior part of the third ventricle. The roof, which is seen to be very thin, is, in the adult, represented merely by the layer of endothelium covering the under surface of the velum interpositum. The choroid plexuses of the third ventricle have not yet developed. The slit-like character of the cavity of the third ventricle is due to the thickening which takes place in its lateral walls, forming the optic thalami, the anterior extremities of which are seen in section. The apertures (really canals) which are seen connecting the third ventricle and the lateral ventricles represent the foramen of Monro, which at this period of development is still of a considerable size. In sections a little farther back in the series, that is to say behind the foramen of Monro, the corpora striata and optic thalami fuse with one another, so that in this situation the lateral ventricles appear to have no communication with the third ventricle.

If we now compare the brain of this seventh-week embryo with the hydrocephalic brains just described, we shall find that the resemblance is largely confined to the condition of the cerebral hemispheres; in both, the ventricles are cystic, and the cerebral mantle exceedingly thin. On examining the cerebral mantle of the embryo brain more closely, we find that it contains very little white matter

Here, just as in the spinal cord, the white matter develops at a later period. This may possibly serve to explain how it is that in hydrocephalus the cerebral mantle is represented almost entirely by grey matter, and why the corpus callosum is so imperfectly developed. Of course, it may be argued that these structures have been developed, but have subsequently atrophied from pressure. It is difficult to say which of the two factors is the more important. On comparing the remaining parts of the hydrocephalic brains with that of the embryo, we find that in the former the parts, with the exception of the corpus callosum, and possibly also of the fornix, are all present in a comparatively well-developed condition. It would seem, therefore, that the arrest of development, assuming it to exist, is almost restricted to the hemisphere vesicles. As to the cause of the arrest, nothing is known. If it be primary, and if it does not involve the cranial box, then the ventricles become filled with cerebro-spinal fluid to occupy the vacuum (hydrops ex vacuo); more probably, however, the arrest is secondary to an undue secretion poured out by the vital activity of the cells covering the coroid plexus, cells which appear to undergo a specialisation both of structure, and probably also of function, at a comparatively early stage of development. Should this occur, it is easy to see how the increased pressure within the lateral ventricles would lead to the arrest of development and to the permanently cystic condition of the hemisphere vessels, followed, in the majority of instances, by an expansion of the mesoblastic structures which support them. It is interesting to note, in this relation, that hydramnios has frequently been observed to exist along with hydrocephalus of the fœtus. The fluid in hydrocephalus appears to have the same composition as cerebro-spinal fluid, a fluid which, in consequence of the absence of albumen, of the presence of a copper-reducing substance, and, according to Halliburton, the presence also of albumoses, is regarded by physiologists as a secretion due to the vital properties of the cells lining the choroid plexuses, and possibly also of those lining the ventricle generally.

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DESCRIPTION OF PLATE XX.

Third ventricle and floors of lateral ventricles, viewed from above. (Dr. Bruce's specimen ; natural size.)

F.C., falx cerebri ; *C.C.*, corpus callosum ; *S.L.*, remains of septum lucidum ; *C.H.*, wall of cerebral hemisphere ; *F.M.*, foramen of Monro ; *C.N.*, caudate nucleus ; *F.*, fornix ; *M.C.*, middle commissure ; *Op.Th.*, optic thalamus ; *Aq. Sy.*, aqueduct of Sylvius ; *Hy.M.*, hypocampus major ; *P.C.*, posterior commissure ; *V.I.*, cut edge of velum interpositum, covered by fibres of fornix ; *3rd Vb.*, posterior part of third ventricle ; *Cy.*, choroidal cyst ; *C.P.*, choroid plexus ; *D.C.*, descending cornu of lateral ventricle ; *3rd Va.*, anterior part of third ventricle ; *C.A.*, corpus albicans ; *A.C.*, anterior cornu of lateral ventricle.


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